Nos. 2015-1728, -1729, -1730

United States Court of Appeals for the Federal Circuit

CHICAGO BOARD OPTIONS EXCHANGE, INCORPORATED,

Appellant,

v.

INTERNATIONAL SECURITIES EXCHANGE, LLC,

Appellee.

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. CBM2013-00049, CBM2013-00050, and CBM2013-00051.

OPENING BRIEF OF APPELLANT CHICAGO BOARD OPTIONS EXCHANGE, INCORPORATED

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September 18, 2015

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CERTIFICATE OF INTEREST

I, Steven Lieberman, counsel for Appellant Chicago Board Options Exchange, Incorporated, certify the following:

1. The full name of the party represented by me is Chicago Board Options Exchange, Incorporated.

2. Chicago Board Options Exchange, Incorporated is the real party in interest.

3. All parent corporations and publicly held companies that own 10 percent or more of the stock of this party are: Chicago Board Options Exchange, Incorporated is a wholly owned subsidiary of Chicago Board Options Holdings, Inc., a publicly held corporation.

4. The law firms and the partners and associates that appeared for this party in the Covered Business Method cases at the U.S. Patent and Trademark Office, Patent Trial and Appeal Board, or are expected to appear in this Court are:

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TABLE OF ABBREVIATIONS

CBOE or Patent Owner-Appellant	Chicago Board Options Exchange, Incorporated
ISE or Petitioner-Appellee	International Securities Exchange, LLC
the ’498 Patent	U.S. Patent No. 7,356,498
the ’457 Patent	U.S. Patent No. 7,980,457
the ’044 Patent	U.S. Patent No. 8,266,044
the CBOE Patents	The ’498 Patent, the ’457 Patent, and the ’044 Patent, collectively
§ 101	35 U.S.C. § 101
the Board	The Patent Trial and Appeals Board
CBM	Covered Business Method
IPR	*Inter Partes* Review

STATEMENT OF RELATED CASES

This case is a consolidation of *Chicago Board Options Exchange, Incorporated v. International Securities Exchange, LLC*, Appeal Nos. 2015-1728, 2015-1729, and 2015-1730. Dkt. 2. This is a companion case to *International Securities Exchange, LLC v. Chicago Board Options Exchange, Incorporated*, Appeal Nos. 2015-1743 and 2015-1744, which are consolidated appeals from related *Inter Partes* Review ("IPR") proceedings and have been assigned to the same merits panel as this case. *Id*.

No previous appeals have been taken from this case to any appellate court. This case is related to *Chicago Board Options Exchange, Incorporated v. International Securities Exchange, LLC*, No. 1:13-cv-01339-JMF (S.D.N.Y.), which was stayed pending the outcome of the post-grant proceedings and has now been administratively closed. Appellant is unaware of any other case that will directly affect or be directly affected by this Court's decision in the pending appeal.

JURISDICTIONAL STATEMENT

This appeal is from three Covered Business Method ("CBM") reviews before the United States Patent Trial and Appeal Board (the "Board"). On March 2, 2015, the Board determined that all claims of U.S. Patent Nos. 7,356,498 (the "'498 Patent"); 7,980,457 (the "'457 patent"); and 8,266,044 (the "'044 Patent")

(collectively the "CBOE Patents") are unpatentable under 35 U.S.C. § 101. A1-86. On the same date, the same panel held that the claims of the '498 and '457 Patents are not invalid under §§ 102 or 103 in the two related IPR proceedings. Appellant timely filed its Notices of Appeal on May 1, 2015. Accordingly, this Court has jurisdiction over this appeal pursuant to 28 U.S.C. § 1295(a)(4)(A), 35 U.S.C. § 329, and 35 U.S.C. § 141(c).

PRELIMINARY STATEMENT

Patent Owner-Appellant Chicago Board Options Exchange, Incorporated ("CBOE") is the largest and oldest options exchange in the United States. A1374. In the late 1990's, and over the course of several years, CBOE developed a new, automated exchange trading system for the electronic trading of securitized instruments. A1375. This improved system addressed a particular technical problem with electronic exchanges that did not exist with human-operated exchanges. A96. CBOE's solution is the subject of the claims at issue in this appeal.

This case presents unique and important issues to this Court.

First, to CBOE's knowledge, this is the first CBM appeal where the Board found that the claims were new, non-obvious, and valid in an IPR proceeding, yet rejected the same claims under § 101 because it found, *inter alia*, the claimed invention involved only "well-understood, routine, conventional" activities. The

CBM and IPR appeals are being briefed to the same panel, so this Court will have a complete view and full understanding of these inconsistent decisions.

Second, the patented invention – invented and owned by an exchange and infringed by a rival exchange – is related to safeguards for an automated exchange trading system, which is the technological backbone of modern-day electronic exchanges. It is not related to trading strategies, market maker hedging techniques, or economic principles. This invention provides system improvements aimed at preventing disruptions of securities markets. It is critical to ensuring the orderly operation of those financial markets. If inventions such as those at issue here are, as a class, patent ineligible, then the owners of electronic exchanges will be unable to protect innovations that safeguard such exchanges from crashes, hackers, and traders seeking to exploit their trading systems.

STATEMENT OF THE ISSUES

The ultimate issue in this appeal is whether the Board erred in finding the claimed improvements to automated exchange trading system technology, which the same panel concluded are novel and non-obvious, are nevertheless ineligible for patent protection under 35 U.S.C. § 101. These improvements were a technological solution to a new problem caused by the advent of electronic exchanges. Subsidiary issues illustrating the Board's errors include:

1. Whether the Board improperly construed the claims by reading out express claim limitations, including the "automated exchange trading system" in the preamble and the step of "automatically modifying" in the body of the claims.

2. Whether the Board erred, as a matter of law, in concluding that the claimed invention consisted of nothing more than routine and conventional steps that could be performed on a general purpose computer or manually.

3. Whether the Board erred, as a matter of law, in concluding that a technological improvement to an exchange trading system was not patent eligible.

4. Whether the Board failed to comply with the Administrative Procedure Act ("APA") when it did not address critical evidence, including admissions of ISE's expert, regarding: (a) what was "routine and conventional" with respect to the claimed invention; (b) the differences between traditional, manual open outcry and electronic exchanges; and (c) the complex and specific systems required to practice the CBOE patent claims.

STATEMENT OF THE CASE

I. PROCEDURAL HISTORY

A. The District Court Litigation

On November 12, 2012, CBOE sued its direct competitor International Securities Exchange, LLC ("ISE") for infringement of the CBOE Patents, which relate to improvements to, and methods of operating, an automated exchange trading system. A1372-79. CBOE alleges that ISE's exchange trading system

infringes the CBOE Patents. *Id*. ISE has described its system as "a world-class, state-of-the-art trading system" that "can serve as the common technology backbone" for various other exchanges. [1]

On November 1, 2013, the district court granted ISE's motion to stay the infringement proceedings in view of the post-grant review proceedings before the Board.

B. Post-Grant Review Proceedings Before the Board

In September 2013, ISE requested CBM review of the CBOE Patents. In March 2014, the Board instituted CBM proceedings with respect to each of the CBOE Patents on only one ground – that the claims do not present patent eligible subject matter under 35 U.S.C. § 101. One year later, in March 2015, the Board determined that the claims of each of the CBOE Patents are not patent eligible under § 101. A1-86. These decisions are the subject of the current appeal.

ISE also petitioned for *Inter Partes* Review of the CBOE patents, alleging that all claims were invalid under 35 U.S.C. §§ 102 and 103. The Board instituted an IPR proceeding with respect to only the '498 and '457 Patents and declined to initiate an IPR for the '044 Patent, finding that ISE failed to show it could prevail on its invalidity challenge. A2194-2207.

[1] ISE Press Release, dated April 11, 2011, available at http://www.ise.com/press-room/press-releases/ (accessed August 10, 2015).

On the same day as the Board's CBM decisions, the same panel determined that ISE had failed to show that the claims of the '498 and '457 Patents were either anticipated or obvious. *Int'l Sec. Exch., LLC, v. Chi. Bd. Options Exch., Inc.*, No. IPR2014-00097, 2015 WL 930271 (P.T.A.B. Mar. 2, 2015); *Int'l Sec. Exch., LLC, v. Chi. Bd. Options Exch., Inc.*, No. IPR2014-00098, 2015 WL 930272 (P.T.A.B. Mar. 2, 2015). ISE's appeal of that ruling is the subject of the consolidated companion cases Appeal Nos. 2015-1743 and 2015-1744.

II. BACKGROUND

A. Financial Exchanges

Each of the parties in this case is a large "exchange." Exchanges use systems that enable traders to buy and sell securitized instruments, such as stocks, commodities and derivatives.[2] Like banks, exchanges must protect other people's money against theft, destruction, fraud, and hacking. Exchanges must also ensure that trades are carried out in a swift and efficient manner. Examples of other well-known exchanges are the New York Stock Exchange ("NYSE") and NASDAQ.

[2] The type of derivatives traded on the exchanges at issue in this case are options contracts, which convey certain rights to buy or sell an underlying stock, commodity, or other security at a fixed price for a specific period of time. A96. Options exchanges depend on proprietary traders called "market makers" to create liquidity (*i.e.*, to make the market) for investors by providing "quotes," which are a market maker's bid(s) and/or offer(s) on one or more options contracts. A1492.

Although exchanges in the United States are non-governmental public entities, they are subject to significant government oversight due to their importance to the national economy. For example, the government has mandated that exchanges implement system improvements to address "system disruptions, system compliance issues, and system intrusions" caused by advances in technology. *See* SEC Release No. 34-73639, RIN 3235-AL43. As the SEC has explained:

> technological advances have generated an increasing risk of operational problems with automated systems, including failures, disruptions, delays, and intrusions. Given the speed and interconnected nature of the U.S. securities markets, a seemingly minor systems problem at a single entity can quickly create losses and liability for market participants, and spread rapidly across the national market system, potentially creating widespread damage and harm to market participants, including investors.

Id. (emphasis added). Thus, the SEC has publicly recognized that technological advances in the exchanges themselves have created new and serious problems that did not exist when trades resulted from human interaction. These new and serious problems created by "technological advances" require new technological solutions.

Most exchanges now use electronic trading systems. Prior to the advent of electronic exchanges, options were exclusively traded manually on the "floor" of an "open outcry" exchange, named for its verbally-communicated mechanism for generating trades. A1493-1499. Open outcry is a "vanishing method of communicating on [an] … exchange that involves verbal bids and offers as well as

hand signals to convey trading information."[3] In open outcry, a "contract is made when one trader cries out that they want to sell at a certain price and another trader responds that they will buy at that same price." *Id*.

Exchanges continuously work to improve their trading systems. In addition to speed and accuracy, exchanges must safeguard against new and diverse threats, including cyber-attacks, infrastructure limitations, and traders seeking to exploit the technology that underlies electronic exchanges. These concerns require constant improvements. Because of the high degree of transparency required by regulators and investors, "trade secrets" are generally not an option to protect technological improvements by the exchanges. Therefore, exchanges seek patent protection for their system improvements and technological safeguards.

A New York Times article[4] about a recent event on the NYSE illustrates the serious concern that even a minor issue within an exchange's trading system can halt all trading completely, with significant consequences to entire financial markets:

> [T]hose working on the trading floor were left helpless when the computer systems at the exchange went down for nearly four hours in

[3] *Open Outcry*, Investopedia, http://www.investopedia.com/terms/o/openoutcry.asp (accessed Sept. 9, 2015).

[4] N. Popper, *The Stock Market Bell Rings, Computers Fail, Wall Street Cringes* (July 8, 2015), http://www.nytimes.com/2015/07/09/business/dealbook/new-york-stock-exchange-suspends-trading.html?_r=1.

> the middle of the day, bringing an icon of capitalism's ceaseless energy to a costly halt.

Id. This could not have happened in a manual, open outcry system:

> "When we traded physically we didn't have these problems, but this is the world that we live in," said Ted Weisberg, a trader … who has been on the floor of the New York Stock Exchange for nearly 50 years.

Id. Although there are advantages to electronic trading, it has also caused new technological problems.

B. The Parties

The parties in this case are two brick and mortar companies that compete in a single industry. Given the nature and relationship of the parties, this is very much a "traditional" infringement case. CBOE developed and patented certain technology; another company, ISE, is using CBOE's patented technology without permission or payment. This is no different than classic disputes like Polaroid versus Kodak, or more recently, Apple versus Samsung. However, largely because the technology at issue – automated exchange trading systems – is used in the financial industry, the Board has deemed CBOE's invention ineligible for protection and ISE's theft of this technology continues unrestrained.

1. CBOE

CBOE was formed in 1973 and is the oldest and largest options exchange in the United States. A1374. Today, CBOE employs more than 500 individuals and offers options on over 2,200 companies, 22 stock indices, and 140 exchange-traded

funds ("ETFs"). In 2012, CBOE's exchange trading system handled over one billion options contracts and over sixty five million transactions. A1483.

Since CBOE's formation, trading on exchanges has largely migrated from human trading via verbal communication to electronic trading. In the late 1990's, CBOE recognized that the change to electronic trading on automated exchange trading systems had left market makers vulnerable to a new type of risk – a risk that did not exist before. *See* discussion, *infra* at Section III.B. A flaw existed in the operation of the then-existing automated systems that could be exploited with catastrophic results to market makers, and by extension, the market as a whole. Accordingly, CBOE developed an improved exchange trading system – described and covered by the CBOE Patents – with safeguards to address the new problems created by electronic exchanges.

2. ISE

ISE is one of CBOE's primary competitors and has operated its own electronic options exchange since 2000. A1440. After its launch, ISE modified its exchange trading system to incorporate the claimed features of the CBOE Patents to encourage market makers to use its exchange. ISE calls this addition to its trading system "Speed Bump." *See* A1451-65. As stated by ISE, it "implemented the Speed Bump because, without it, market makers would not input quotes with any meaningful size." A1439-50.

III. THE TRANSITION FROM HUMAN OPEN OUTCRY EXCHANGES TO ELECTRONIC EXCHANGES

In the late 1990's and early 2000's, there was a paradigm shift in the exchange industry from human open outcry exchanges to electronic exchanges. While open outcry exchanges were based on human-to-human interactions and individual agreements to reach a trade, electronic exchanges operated in a fundamentally different manner.

A. Open Outcry Market Makers Exercised Their Mental Judgment and Used Verbal Communication Before Agreeing to a Trade

In traditional open outcry exchanges, the market makers of a "pit" (the designated location where specific options were traded) would collectively determine a quote that would be posted on monitors above the pit (the "pit quote"). A1494. Thus, in open outcry exchanges, and unlike electronic exchanges, quotes were not tied to an individual market maker. A1751-52 (ISE's expert agreeing that quotes did not have a specific size and "were not tied to any individual market maker"). Rather, the pit quote represented the aggregate "inside market" (highest bid and lowest offer) of all the market makers in a pit. A1494. Moreover, in open outcry exchanges, no quantity was disseminated with a pit quote. *Id*. In other words, in an open outcry system quotes were essentially anonymous, and the size available at any given price was not set until a broker approached the pit with an

order. Only at this time would an individual market maker communicate his size in response to the broker. A1495-97.

Additionally, market makers in open outcry exchanges were not obligated to fill the first order that attempted to trade at the disseminated price. Rather, open outcry exchanges implemented "firm quote" requirements which obligated market makers to trade at the disseminated price for only "public customer orders." *Id.* Under these "firm quote" requirements, the entire pit in aggregate – not each individual market maker – was obligated to fill a total of (typically) 10 contracts for a public customer order. Thus, for example, ten different market makers could fill the pit's obligation by each taking one contract at the disseminated price. In this way, the minimal risks created by exchange requirements were dispersed and shared among all the market makers in the entire pit. *Id.*

Moreover, in open outcry exchanges, market makers verbally issued quotes after orders or a request for a quote were communicated to the market maker. A1496-97. Open outcry trades never occurred without the market maker's knowledge and involvement, and never occurred without the market maker being able to make his own evaluation of the trade before accepting. *Id.* In fact, ISE's own expert admitted that:

> (1) "trades would never happen without a market maker [in the pit] knowing about it;"

(2) "a trade in the open outcry pits for options was triggered by … walking up and asking the pit for the bid or offer;" and

(3) "the market maker could then choose how to respond, or even whether or not to respond at all, except for the obligation to do a transaction for the minimum amount."

A1751-56 (emphasis added).

Trades in open outcry exchanges were, in effect, made "on-demand" and one at a time, in the following manner:

1. A broker would call out the option he wanted to trade. Market makers would respond with a quote (*i.e.* bid and/or offer).
2. If the broker's order allowed the broker to sell at the bid (or buy at the offer), the broker would then verbally communicate with a market maker.
3. At this time, the broker would disclose the quantity of his order, allowing the market maker to determine the quantity (*e.g.*, number of contracts) the market maker wanted to trade before executing the trade.
4. Once the broker and market maker agreed to terms, the trade was recorded for price reporting.

A1496-97. Thus – and in stark contrast to electronic exchanges – trades in traditional open outcry exchanges: (i) were based on human thought, human

interaction, and human decisions, (ii) never occurred without the market maker's knowledge and consent, and (iii) happened one at a time and never occurred en masse.

B. Electronic Exchanges

Electronic exchanges are constructed of an extensive network of computers, which typically include servers, databases, and switches that have been specially programmed to execute various exchange functions. A1499-500; A1536-45 (explaining the uniquely programmed and highly complex system necessary to perform the functions of an electronic exchange trading system). Typically, market makers and brokers submit quotes and orders via their own computers, often from various parts of the world, without communicating directly with each other. A1499-1500. That is, electronic exchanges are extensive networks of computers that communicate with other specially programmed computers to perform specific tasks, including, for example, placing orders and quotes and executing trades.

1. The Industry Change to Automated Electronic Exchanges Caused a Significant Change in Market Maker Obligations

Electronic exchange market makers must fulfill certain responsibilities with respect to quoting in order to maintain their designation as market makers. A1500-01. These responsibilities are very different than those for market makers on open outcry exchanges. *Id*.

For example, in electronic exchanges, unlike in the pit of a traditional open outcry exchange, market makers are required to submit quotes from remote computers that have a specific size (*e.g.*, number of contracts the market makers are obligated to buy or sell), are uniquely associated with that market maker, and persist in the trading system. *Id*. Moreover, these market makers are typically required to provide quotes for all the different options series for which they are a market maker. *Id*. Given these requirements, electronic exchange market makers often must maintain thousands of active quotes, which persist in the trading system until they are either (i) traded or (ii) cancelled. *Id*. Thus, whereas in an open outcry system an individual market maker provided a quote and size in response to a broker's verbal order, quotes on an electronic exchange are made regardless of whether there is a request and remain available in the system until acted upon (*e.g.*, traded). *Id*. Quoting by a market maker on an electronic exchange is thus significantly different than quoting on open outcry.

Trading on an electronic exchange also is completely different than trading in a human open outcry system. Importantly, electronic exchanges execute trades without any verbal communication between the market maker and the broker. Market makers find out that a trade has executed only after the trade is completed when they receive the fill report (the equivalent of a receipt). This distinction is critical. In open outcry exchanges, a market maker would himself decide before

any trade was done whether to: (a) make the trade; (b) not make the trade; or (c) make a trade for a limited number of shares. In stark contrast, in an automated trading system, the market maker can have all of his outstanding quotes hit nearly simultaneously, for hundreds or thousands of trades, and learn of the trades only after they are made.

Additionally, the speed of electronic trading is infinitely faster than human outcry trading. In fact, the speed at which electronic exchanges execute trades is limited only by the technological capabilities of the exchange, not by the market maker (as in open outcry). A1505-06. Consequently, the electronic exchange may generate thousands of trades for an individual market maker within a fraction of a second. A1502-03. Accordingly, in an automated trading system, a market maker could suffer a catastrophic loss by agreeing to thousands of trades without even knowing it. As explained by the Commodity Futures Trading Commission ("CFTC") in its Concept Release on Risk Controls and System Safeguards in Automated Trading Environments:

> U.S. derivatives markets have experienced a fundamental transition from human-centered trading venues to highly automated and interconnected trading environments…. Traditional risk controls and safeguards that relied on human judgment and speeds, and which were appropriate to manual and/or floor-based trading environments, must be reevaluated in light of new market structures.

A2108-09 (Sept. 12, 2013); A1731-35 (ISE's expert, agreeing with the CFTC's assessment).

Moreover, before CBOE's invention, the only way in which a market maker could modify his remaining quotes in an electronic exchange was to send a message cancelling or modifying the quote from an external computer. These messages were, and still are, placed in a message queue – an electronic list of the messages processed in order of arrival. *See* A96. However, message queues are subject to latency delays caused by physical constraints such as Internet and data network designs, as well as delays in processing. A1510-12. These latency delays allow the electronic exchange system to execute additional trades before the system processes the cancellation or modification message, forcing the market maker to participate in countless unwanted trades. *Id*. By way of example, even if a market maker recognized a problem instantly and wanted to immediately cancel his outstanding quotes, the message could be placed in the system queue behind hundreds or thousands of orders that would be executed before the cancellation order is processed.

2. CBOE's Recognition of a Significant Problem with Automated Exchange Trading Systems

With the paradigm shift to electronic exchanges came a new problem - market makers could now be forced to unwillingly make trades across many quotes. CBOE recognized this problem and the need to improve automated exchange trading systems to include a safeguard against this new, and unaddressed,

risk to market makers. This improved system, and corresponding method of operating an exchange trading system, is the subject of the CBOE Patents.

In traditional open outcry exchanges, it was impossible for a market maker to make large unwanted trades because of the nature of open outcry trading, including the human interaction (*i.e.*, verbal and conscious pre-trade negotiation, self-limiting trade execution, pit quotes without size, and near-nominal firm pit quote obligations). A1504-06. An open outcry market maker did not need to "modify" or change his quotes in response to anything; he just quoted a different size before agreeing to trade.

The electronic exchange presented a new type of risk to market makers - a vulnerability to catastrophic loss due to the way in which automated exchange trading systems operate. This new type of risk, not seen in open outcry exchanges, was caused by the unique characteristics of electronic exchanges implemented on an automated exchange trading system, namely:

(1) the dissemination of persistent electronic quotes with size associated with an individual market maker,

(2) individual firm quote requirements to meet the disseminated size,

(3) non-verbal high-speed trade matching and execution by which a market maker may be unaware of trades, and

> (4) the inability to cancel or modify quotes prior to additional executions due to latency delays such as those caused by electronic message queues.

A1504-13. In the late 1990's, then-existing automated exchange trading systems had no safeguards that could address this new problem, and as such, were fundamentally flawed and at risk. A1514-15.

Accordingly, market makers could not simply use traditional open outcry risk management techniques, or trader-side software tools, to protect themselves from these new aforementioned vulnerabilities. A1509-10. The risk management hedging techniques used by pit-based market makers were designed to allow market makers to manage risks of trades they manually and voluntarily made. *Id*. There was nothing in the risk management hedging techniques of pit-based market makers that could defend against the risk of a market maker being forced into multiple, rapid, unwanted trades by an automated exchange trading system, because that problem did not exist. *Id*. Similarly, traditional open outcry risk techniques could not overcome the inability to cancel or modify quotes prior to additional executions due to latency delays such as those caused by electronic message queues.

IV. THE AUTOMATED EXCHANGE TRADING SYSTEM IMPROVEMENTS CLAIMED IN THE CBOE PATENTS

The claims of the CBOE Patents are directed to an improved automated exchange trading system able to defend against a new electronic exchange-created problem. The claims do not claim risk-management techniques used in open outcry exchanges.

Claim 1 of the '498 Patent is representative of all the claims at issue in this appeal. It reads:

> 1. A method of modifying quotes in an automated exchange trading system comprising the steps of:
>
> > [a] receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;
> >
> > [b] generating a trade by matching said received orders and quotes to previously received orders and quotes;
> >
> > [c] storing each of said orders and quotes when a trade is not generated;
> >
> > [d] determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
> >
> > [e] comparing said aggregate risk level with said risk threshold; and,
> >
> > [f] automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded.

A104 (emphasis added). By its own terms, the claim is to a "method of modifying quotes in an automated exchange trading system comprising the steps of … automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded." *Id*.

The automated exchange trading system receives electronic "quotes" that are associated with a new "trading parameter" claimed as a "risk threshold," which can be set by the market maker. *See id*.; A101. After "generating a trade" involving the market maker's quotes, if the market maker's threshold is exceeded, the exchange trading system can "automatically modify[]" one or more of the market maker's remaining quotes. The claimed modification can be, for example, revising the price or quantity, or cancelling one or more of the market maker's quotes that would have otherwise been available for execution. This claimed modification is done "automatically" by the "automated exchange trading system" itself; *i.e.*, without further input from the market maker. The claimed method of operating an automated exchange trading system does not leave the market maker vulnerable to the new risks addressed above.

As confirmed by the specification, "quotes are modified by the exchange system in an automatic manner that does not require further input from the market-maker in the form of quote cancellation requests and submission of new quotes by the market-maker or his computer." A103. The claimed trading system performs

quote modification automatically and immediately, bypassing and overcoming the transmission delays inherent in communication systems and the delays associated with processing queued cancellation requests received from a remote location. *Id.*; A1502-1503.

The specification provides examples of the hardware and software modules necessary to perform the claimed method. For instance, in a preferred embodiment, to submit quotes, market makers log into a client application server module, via a workstation or handheld unit, and access the user service module. A101. "[T]rading parameters" associated with the quote are sent to the quote service module. *Id.* The quote service module "receives [the] quotes from market makers" and provides these quotes to the broker service module. *Id.*

The automated exchange trading system also "receiv[es] orders" to match with quotes and thus generates trades. The orders received by the client application server are routed to an order handling service and then sent to the appropriate broker service module. A101. Then, the broker service module generates a trade by matching said received orders and quotes with the best order and quote in the order book. *Id.* When a trade is generated, a fill report is issued to the quote service module. *Id.* "The quote service module then determines whether the market-maker's risk threshold has been exceeded." *Id.* If the risk threshold is exceeded, the quote service module of the exchange system "performs

quote modification by…automatically revising, canceling or regenerating quotes," without further decision or action from the market maker, to reduce a market-maker's exposure. A102-103. All this is done electronically in a specifically claimed automated exchange trading system.

An exemplary illustration of the "interconnection of various software modules associated with the quote risk monitoring and modification trading system" are provided in the figures. A90-92, 97. FIG. 2B, for instance, illustrates the Order Handling Service module 210, the Broker Service Module 230, and the Market Maker (MM) Quote Service module 240, as well as their relationships to other modules and external sources:

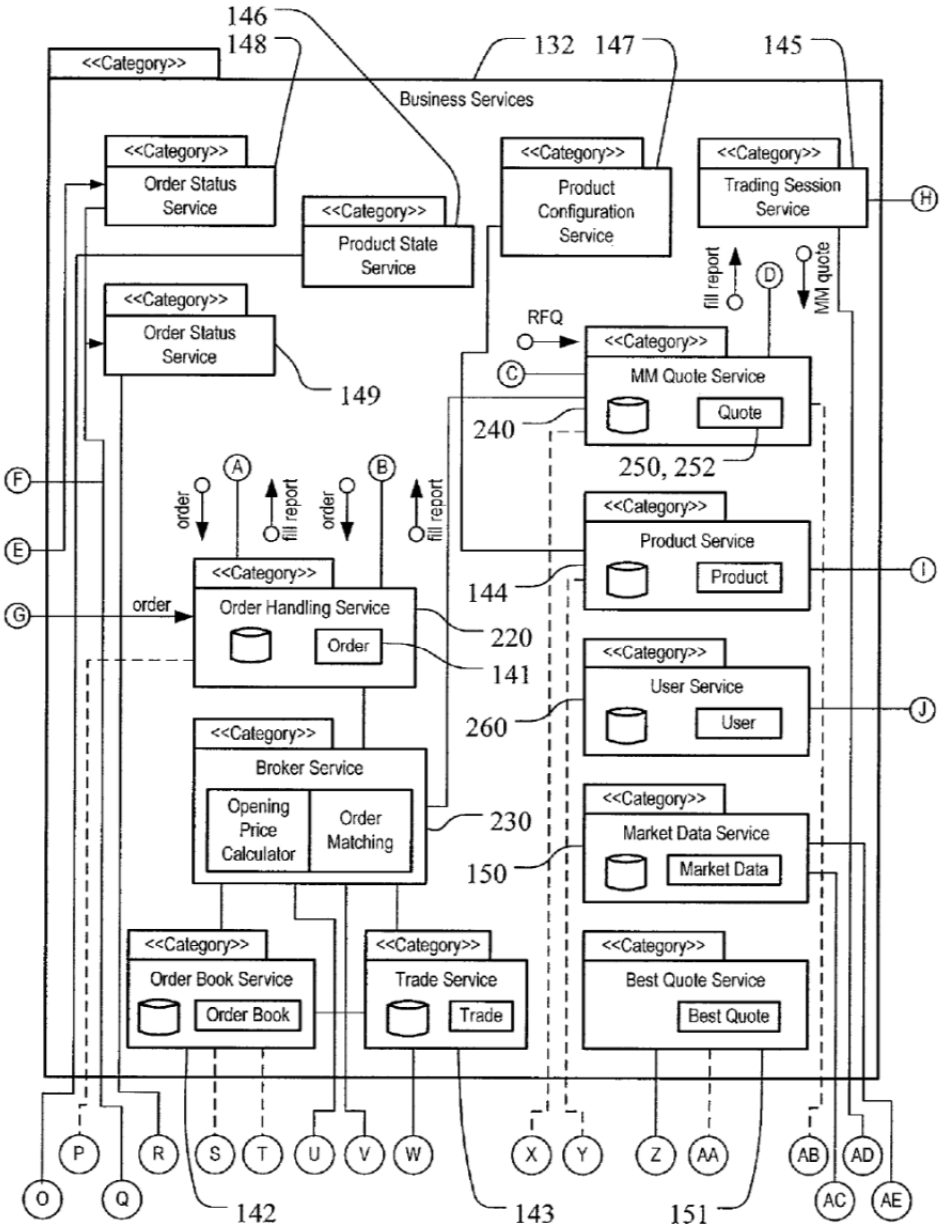

Fig. 2B

A91.

As detailed in the specification, the claimed quote modification is preferably performed in one of three ways. First, "the quote service module [may revise] quotes by canceling all outstanding quotes in the class, thereby preventing any further trades from executing and giving the market-maker time to provide revised

quotes." A103 (internal reference numbers omitted). "In this embodiment, the quote service module sends quote update messages in the form of cancellation messages to the broker service module." *Id*. "The broker service then removes those quotes from the electronic book." *Id*. This embodiment provides the above-mentioned advantages of the claimed invention, such as eliminating a cancelled message queue. *See id*.

The second and third ways include modifying quotes by reducing the quantity associated with existing quotes or making the remaining quotes less desirable to customers, and thus, less likely to be executed. Specifically, if the risk threshold is exceeded, "the quote service module sends quote updates by first sending quote cancellation messages to the broker service module, and after acknowledgment, sending the revised quotes to the broker service module for execution or booking." *Id*.

Thus, the specification provides a detailed explanation of the hardware and software modules of the machine necessary to implement the claimed improvement to automated exchange trading system technology.

Equally as important as what the CBOE Patent and claims <u>are</u>, is what they are <u>not</u>.

1. The claims are not methods or systems for "hedging risk" or trading strategies. They do not cover any of what human market makers do to implement their strategies, either mentally or using their own software and related tools.

2. The claims are not directed to a method of doing business or the practice of any economic principles. While the automated exchange trading system is used in the financial industry, this does not transform the operation of this system into a "business method" any more than an improvement to a bank safe or an ATM would be a "business method" because it is used in the financial industry.

3. The claims do not cover, and are not analogous to, the "risk management" performed by human market makers in the traditional open outcry setting. The claims have express limitations like "receiving orders and quotes," "generating a trade," "storing each of said orders and quotes" and all must be done "automatically" on "an automated exchange trading system."

4. The claims cannot be and never were performed by a human or in open outcry; the risk mitigated by the claimed invention is unique to automatic exchange trading systems. So are the claimed solutions. Critically, human market makers continue to perform traditional risk management, unimpeded by the CBOE Patents.

5. The claimed invention cannot be, and is not performed by, a general purpose computer. Such a conclusion would ignore: (i) numerous express claim limitations; (ii) the specification; (iii) the prosecution history; (iv) testimony

provided by the sole technical expert in this administrative proceeding, Dr. Sandholm; and (v) the reality of exchange trading.[5]

V. THE BOARD'S DECISIONS

A. The CBM Proceedings

In its CBM decisions, the Board determined that the claims of the CBOE Patents are ineligible under § 101. *See* A27-28. The Board erroneously found that the claims were directed to the abstract idea of "managing trading risk…an economic practice long prevalent in our system of commerce and squarely within the realm of abstract ideas." A10-11. In doing so, the Board incorrectly decided that the claims were similar to the concept of intermediated settlement in *Alice*, the concept of risk hedging in *Bilski*, and analogous to the "prior art 'open outcry' exchanges." A11. The Board's decision is premised on both legal and factual errors, including:

- its determination that a technological improvement is not patent eligible,
- its decision to read out the "automated exchange trading system" from the claims,
- its failure to discuss critical evidence and admissions in the record,

[5] *See Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 59 F. Supp. 3d 974, 994-95 (C.D. Cal. 2014) ("Pencil-and-paper analysis can mislead courts into ignoring a key fact: although a computer performs the same math as a human, a human cannot always achieve the same results as a computer.").

- its misunderstanding of the differences between human "open outcry" exchanges and electronic exchanges,
- its determination that the claims could be performed on a general purpose computer, and
- its determination that the claims could be performed manually.

B. The IPR Proceedings

On the same day, the same panel issued its IPR decisions, concluding that the claims of the CBOE Patents are not anticipated, and would not have been obvious in light of the cited art. *See Int'l Sec. Exch., LLC*, 2015 WL 930271, at *1. That is, despite nearly a year of searching for the "best" prior art, ISE could not show that the limitations of the claims in the CBOE Patents were known or obvious over the prior art.[6]

The Board properly concluded that "[ISE] has not established by a preponderance of the evidence that claims 1 and 8 are anticipated by Tilfors [U.S. 6,405,180]," ISE's primary reference, because the reference failed to disclose "determining a risk level and an aggregate risk level associated with said trade." *Id*. at *8-11. Because the reference failed to show the "determining" step, the subsequent steps in the independent claims ("comparing" and "automatically

[6] ISE represented to the district court that the reason it delayed nearly a year in filing for post-grant review was that it had commissioned multiple prior art searches. A2156-58.

modifying" based on said determination) were not disclosed either. Further, the Board found that ISE's secondary reference failed to cure Tilfors's deficiencies, and thus, the remaining dependent claims for which the Board instituted review were not obvious in view of the prior art. *Id*. at *11.

Although the panel that issued the decisions in the IPRs was the same panel that issued the decisions in the CBMs, the CBM decisions do not even refer to – much less discuss – this determination of validity when discussing whether any claim limitations were "routine and conventional" or if the claims contain an inventive concept.

SUMMARY OF ARGUMENT

The CBM decisions should be reversed. The claims of the CBOE Patents are entitled to patent protection like other technological inventions. The CBOE Patents solve a new problem created by automated electronic exchanges that never existed before. As ISE's own expert admitted, they solve the problem through a "technological improvement" to the operation of automated exchange trading systems. A1879-80. This is exactly the type of invention that the patent system was meant to encourage and reward. Without such patents, it would be prohibitively difficult for exchanges to protect the intellectual property underpinning necessary and critical improvements to automated exchange trading systems.

The claims meet both requirements for patentability set forth by the Supreme Court in *Mayo* and *Alice*. *Alice Corp. Pty. Ltd. v. CLS Bank Int'l.*, 134 S. Ct. 2347, 2354-55 (2014). First, the claims are directed to improved automated exchange trading systems and methods of operating such a system, subject matter within the purview of traditional patent laws and distinct from any "fundamental economic practice long prevalent in our system of commerce." *See Bilski v. Kappos*, 561 U.S. 593, 611 (2010). The claims are not directed to the abstract idea of "risk management," and to say so ignores express claim language, the specification, the record evidence, and the reality of electronic trading.

Second, the claims contain limitations sufficient to ensure that the claim is directed to "significantly more than a patent upon the ineligible concept itself." *Alice*, 134 S. Ct. at 2355 (citation omitted). That is, the claims include an "inventive concept" distinct from traditional risk management – an improvement to then-existing automated exchange trading systems, which contained a significant vulnerability. The claimed solution is tied to automated exchange trading system technology, and is necessary to overcome a problem specifically arising in the realm of electronic exchanges. *See DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1257 (Fed. Cir. 2014).

The Board erred when it held that the preamble of claim 1 of the '498 Patent, which requires an automated exchange trading system, does not constitute a

limitation. Without the necessary context of an automated exchange trading system, the claims of the CBOE Patents lose all meaning. Reading out this limitation is both an error in claim construction and internally inconsistent with the Board's recognition that the CBOE Patents are directed to an automated exchange trading system where "the system provides integrated quote risk monitoring and quote modification services." A5 (emphasis added).

The Board also erred by failing to cite – much less discuss – critical evidence in the record, including:

- CBOE's primary declarant Ross Kaminsky, who is both an inventor of the CBOE Patents and the only market maker to offer testimony in the CBM proceedings;
- the admissions of ISE's own expert regarding critical distinctions between traditional human open outcry exchanges and electronic exchanges;
- the critical admission by ISE's expert that the CBOE Patents embody a "technological improvement" to an exchange;
- testimony explaining that the claim steps could not be performed by a general purpose computer; and
- the IPR decisions and the finding therein that the claimed invention is new and non-obvious.

ARGUMENT

I. STANDARD OF REVIEW

This Court reviews the question of patent eligibility de novo. *See, e.g.*, *In re Bilski*, 545 F.3d 943, 951 (Fed. Cir. 2008). "As a general matter, [this Court] review[s] the Board's conclusions of law de novo and its findings of fact for substantial evidence." *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1297 (Fed. Cir. 2015). This Court has "expressly held that the Board's opinion must explicate its factual conclusions, enabling [it] to verify readily whether those conclusions are indeed supported by 'substantial evidence' contained within the record." *In re Gartside*, 203 F.3d 1305, 1314 (Fed. Cir. 2000) (citing *Gechter v. Davidson*, 116 F.3d 1454, 1460 (Fed. Cir. 1997)). Under the standard set forth in the APA, 5 U.S.C. § 706(2)(E), this Court will set aside the factual findings of the Board that are unsupported by substantial evidence. If the record does not support the Board's decision, if the Board did not consider all relevant factors, or if this Court cannot evaluate the decision based on the record, remand for additional investigation or explanation is warranted. *Fla. Power & Light Co. v. Lorion*, 470 U.S. 729, 744 (1985).

II. THE CLAIMS ARE DIRECTED TO A PATENT-ELIGIBLE IMPROVEMENT TO AUTOMATED EXCHANGE TRADING SYSTEMS

A. The Claims of CBOE's Patents Are to a Patent-Eligible "Automated Exchange Trading System"

The claims of the CBOE Patents – titled "Automated Trading Exchange System Having Integrated Quote Risk Monitoring and Integrated Quote Modification Services" – require an automated exchange trading system. This limitation is expressly recited multiple times both directly and indirectly in the claims of the '498 patent. For example, the claims are to "modifying quotes in an automated exchange trading system" and include the step of "automatically modifying" quotes. A104.[7] The Board erred by reading this limitation completely out of the claims. A13 (determining that the "automated exchange trading system" does not limit the claim scope because it "only appears in the preambles as the environment where the claimed method is performed"). Because the Board incorrectly read out the automated exchange trading system limitation, its entire § 101 analysis was incorrect as a matter of law.

"Whether to treat a preamble as a limitation is a determination 'resolved only on review of the entire ... patent to gain an understanding of what the

[7] In the'457 and '044 Patents, this limitation is "[a] system for processing trades of securitized instruments" configured for "automatically modifying … quotes." A124, A142.

inventors actually invented and intended to encompass by the claim.'" *Catalina Mktg. Int'l v. Coolsavings.com, Inc*., 289 F.3d 801, 808 (Fed. Cir. 2002) (citation omitted) (emphasis added). Although "[n]o litmus test defines when a preamble limits claim scope," there are a number of circumstances in which the preamble is limiting, including "reliance on the preamble during prosecution to distinguish the claimed invention from the prior art" and when "the preamble is essential to understand limitations or terms in the claim body." *Id*. Consideration under either of those examples from *Catalina Marketing* shows that the preambles of the CBOE Patents' claims should have been treated as claim limitations.

1. The Preamble Is Necessary to Understand Limitations and Terms in the Body of the Claims

The Board erred when it determined that the preambles of the CBOE Patent claims are not limiting. This Court reviews the Board's claim construction determinations de novo. *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1280 (Fed. Cir. 2015).

Generally a preamble is considered limiting when it "recites essential structure or steps, or if it is 'necessary to give life, meaning and vitality' to the claim.'" *Catalina Mktg.*, 289 F.3d at 808 (quoting *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999)). For instance, a preamble is limiting if it includes the "essence of the invention." *Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp.*, 320 F.3d 1339, 1345 (Fed. Cir. 2003)

("preamble language will limit the claim if it recites not merely a context in which the invention may be used, but the essence of the invention without which performance of the recited steps is nothing but an academic exercise."). As this Court has explained, "[i]n reviewing the intrinsic record to construe the claims, we strive to capture the scope of the actual invention, rather than strictly limit the scope of claims to disclosed embodiments or allow the claim language to become divorced from what the specification conveys is the invention." *Retractable Techs., Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296, 1305 (Fed. Cir. 2011); *see also Rotatable Techs. LLC v. Motorola Mobility LLC*, 567 F. App'x 941, 943 (Fed. Cir. 2014) (finding the preamble limiting where the "specification is replete with references … underscoring the importance of the feature to the claimed invention").

When the claimed phrase "automated exchange trading system" is ignored, (as the Board did), the claims of the CBOE Patents lose their meaning. For instance, the limitation "automatically modifying at least one of the remaining said specified ones of said quotes in the quote group," as construed by the Board, means "automatically cancelling or revising a price or quantity of at least one of the received specified quotes still available for execution." A7. This action must be performed by an automated exchange trading system. *See, e.g.*, A1545. The same is true of several other claim limitations such as "receiving orders and

quotes" with "trading parameters," "generating a trade by matching said received orders and quotes to previously received orders and quotes," and "storing each of said orders and quotes when a trade is not generated."[8] These limitations are core functionalities of an automated exchange trading system – not a general purpose computer. Only by reading out the express language "automated exchange trading system" was the Board then able to conclude that the claims could be performed either on a general purpose computer or "manually." And, by doing so, the Board divorced the claims from the specification, the prosecution history, the state of the art, and what was invented. The Board's determination ignores the principle that when preamble language is essential to understand limitations in the claim body, that language constitutes a limitation. *See Catalina Mktg.*, 289 F.3d at 808.

Moreover, the Board's decision to read out the claim language "automated exchange trading system," is inconsistent with other portions of its ruling. Specifically, the Board concluded that "[t]he invention of the '498 patent is directed to methods for modifying quotes in an automated exchange trading system, where the system provides integrated quote risk monitoring and quote modification services." A5 (emphasis added). The Board further stated:

[8] ISE's own expert agreed that the steps of "receiving orders and quotes" and "generating a trade by matching said received orders and quotes" are "done by the exchange." A1833-35.

"The '498 patent relates to automated trading systems for option contracts ('options'). Specifically, the claimed invention is directed to methods for managing the risk of a maker of an options market in an automated exchange trading system." A3 (internal citations omitted) (emphasis added). Further, the Board acknowledged that the problem addressed by the claims is unique to automated exchange trading systems. A4 ("One disadvantage of known automated trading systems is…"). The Board's characterization of the claims and CBOE's improvements confirms that reading out the "automated exchange trading system" limitation was incorrect.

Finally, the Board's determination that the preamble is non-limiting is inconsistent with its own claim construction in the IPR proceedings, which it adopted in its CBM decisions. A7. In its IPR decisions, the Board construed the limitation in clause [f] as "automatically cancelling or revising a price or quantity of at least one of the received specified quotes still available for execution." *Id.*[9] The CBM decision is inconsistent with this construction for two reasons. First, the only place in which "received specified quotes" are "still available for execution" is in the automated exchange trading system of the preamble. *See* claim 1 ("A

[9] Similarly, ISE conceded in its proposed constructions that the automated exchange trading system is part of the claim. A1014 (construing the claim term "trading parameters" as "data… provided to the automated exchange trading system") (emphasis added).

method of modifying quotes in an automated exchange trading system") (emphasis added). Second, the step of "automatically modifying" received quotes implicates the preamble – "A method of modifying quotes in an automated exchange trading system." A104 (emphasis added).

2. The Prosecution History Confirms that the Preamble Is Limiting

As this Court has stated, "clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art transforms the preamble into a claim limitation because such reliance indicates use of the preamble to define, in part, the claimed invention." *Catalina Mktg.*, 289 F.3d at 808. CBOE's reliance on the preamble during prosecution further supports the fact that the "automated exchange trading system" is a claim limitation.

During prosecution, CBOE argued (ultimately successfully) that the prior art failed to show "(i) an exchange system that uses a risk threshold associated with a quote; (ii) a risk level or aggregate risk level that is determined as a result of a trade; or (iii) the use of the threshold and aggregate risk level to automatically modify a quote." A1469-74 ("The quote modification screen identified by the Examiner appears to relate to a graphical user interference that allows an individual to selectively modify quotes.") (emphasis added). Similarly, CBOE argued that its claims were patentable by connecting the term "automatically" (in the body of the claim) to the "exchange trading system" of the preamble:

> [I]t is not known to provide an order matching exchange system that allows its users to provide risk threshold information to the exchange, and to have the exchange system perform risk assessment calculations and responsively make automatic determinations regarding quote regeneration or modification in response to the calculated risk.

A1470 (emphasis added). The prosecution history demonstrates that the preamble is a limitation of the claims.

Because the Board incorrectly read out the automated exchange trading system limitation, it failed to treat the claims as an improvement to exchange trading system technology and incorrectly found that the claims could be practiced by a general purpose computer or manually.

B. Automated Exchange Trading Systems, and Improvements Thereto, Are Patent Eligible

Automated exchange trading systems are specially programmed, complex computer systems with functionality well beyond that of a generic computer or server. A1535-48 (Dr. Sandholm describing the substantial hardware and custom built software necessary for an exchange trading system). High-tech and innovative advancements to automated exchange trading systems are exactly the type of invention the patent laws are designed to protect. There is nothing "abstract" about the automated trading systems used every day throughout the country. Exchanges process trillions of dollars in trades, and must perform these trades accurately, consistently, and efficiently. The fact that this technology is used in the financial industry (*i.e.*, to support an electronic exchange) should not

remove it from protection. This is not the type of innovation that the Supreme Court was concerned with in *Alice*.

The Supreme Court has said that method claims that "purport to improve the functioning of the computer itself" or "effect an improvement in any other technology or technical field" are eligible for a patent. *Alice*, 134 S. Ct. at 2359 (emphasis added). The claimed solution here is tied directly to automated exchange trading system technology, and is necessary to overcome a problem specifically arising in the realm of electronic exchanges. *See DDR Holdings*, 773 F.3d at 1257. Technological improvements to automated exchange systems, such as safeguards to prevent exploitation of system weaknesses, are just as eligible for patent protection as are technological improvements in other arts. If improvements to the trading systems that form the basis of our financial markets are deemed "abstract," the harm to investors and the financial markets will be very "real."

Claims directed to a system for electronic trading do not, by definition, encompass the "fundamental economic practice long prevalent in our system of commerce" in the form of open outcry. *See Bilski*, 561 U.S. at 611. As a district court found in another case involving electronic trading, "electronic trading has only been viable for a couple decades, and its analog predecessor, open outcry trading systems, operate in a significantly different fashion." *Trading Techs. Int'l, Inc. v. CQG, Inc.*, No. 05-cv-4811, 2015 WL 774655, at *4 (N.D. Ill. Feb. 24,

2015).[10] This is particularly true where the claims do not tread upon the market participants' rights to implement their longstanding trading strategies and economic practices the way they have historically.

In *Trading Techs.*, the invention was directed to "a display and trading method to ensure fast and accurate execution of trades…" *Id*. at *1. There, the defendant, like ISE, argued that the claims were directed to the abstract idea of "placing an order for a commodity on an electronic exchange," and that the claims "merely perform basic functions relating to electronic commodity trading and…generic computer components." *Id*. at *3-4. However, the district court concluded "in part, from the apparent differences between the analog versions of trading and electronic trading that the claims of the patents in suit are not directed to the abstract idea of 'placing an order for a commodity on an electronic exchange.'" *Id*. at 4. The court in *Trading Techs*. found "the claims are directed to solving a problem that existed with prior art" electronic systems; "this issue did not arise in the open outcry systems, *i.e.* the pre-electronic trading analog," and so was not directed to an abstract idea. *Id*. This conclusion applies with equal force here.

[10] Patents directed to exchange trading systems are not new to this Court. As this Court has construed in a separate case between the present parties, the term "automated exchange" is "a system for executing trades of financial instruments that is fully computerized, such that it does not include matching or allocating through the use of open-outcry." *Chi. Bd. Options Exch., Inc. v. Int'l Sec. Exch., LLC*, 677 F.3d 1361, 1373 (Fed. Cir. 2012).

Improvements to automated exchange trading systems are first and foremost improvements in technology. ISE's own expert agreed that the claimed inclusion of automatic quote modification in a trading system was a "technological improvement." A1879-80. In fact, as is clear from the un-rebutted testimony of CBOE's technical expert Dr. Sandholm, it is hard to image a more "high-tech" field than that of automated exchange trading systems. *See* A1535-48. But what the Board seems to have done is hold that there is a special rule for technological improvements to trading or financial systems, rendering any such invention patent ineligible. *See* A20. However, this is not the law.

C. The Claims of the CBOE Patents Meet the Supreme Court's Test for Patent Eligibility

The Supreme Court has cautioned that in evaluating the issue of whether a patent claims an abstract idea, one must "tread carefully in construing this exclusionary principle lest it swallow all of patent law," because "[a]t some level, 'all inventions . . . embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas.'" *Alice*, 134 S. Ct. at 2354 (citation omitted). When evaluating patent eligibility under § 101, one "must distinguish between patents that claim the 'building blocks' of human ingenuity and those that integrate the building blocks into something more . . . The latter pose no comparable risk of pre-emption, and therefore remain eligible for the monopoly granted under our patent laws." *Id*. at 2354-55.

First in *Mayo*, and again in *Alice*, the Supreme Court articulated a two-part test for determining whether claims are eligible for a patent. *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S. Ct. 1289, 1296-97 (2012); *Alice*, 134 S. Ct. at 2355. As set forth below, the claims of the CBOE Patents meet this test.[11]

1. The Claims of the CBOE Patents Are Not Directed to an Abstract Idea

Under step one of the *Mayo*/*Alice* test, a court "determine[s] whether the claims at issue are directed to one of those patent-ineligible concepts." *Alice*, 134 S. Ct. at 2355. The present claims are directed to an improved automated exchange trading system, and method of operating such a system. This invention is tied to the trading system, recognizes a vulnerability of that system, and provides a safeguard against that vulnerability by using the results of a risk determination to change the operation of the system itself. *See* discussion, *supra* at Sections III-IV.

In its petition for CBM review, ISE simply and summarily argued that the claims of the CBOE Patents are directed to the abstract idea of "managing trading risk." The Board adopted ISE's position (A10-11), ignoring both express claim language (*e.g.*, "automated exchange trading system") and record evidence (*e.g.*,

[11] In order to address the second part of the two-part *Mayo/Alice* test, CBOE is put in the awkward position of assuming an abstract idea is at issue. CBOE was put in a similar position before the Board. To be clear, CBOE does not believe an abstract idea is at issue here and will assume so only for argument's sake to address the second step of the test.

ISE's expert's admission that CBOE's Patents claim a "technological improvement"). In doing so, the Board erred.

a) The Claims Are On the "Diehr" Side of the *Diehr*/*Flook* Spectrum of Patent Eligibility

Diehr is at one end of the patent eligibility spectrum. *See Diamond v. Diehr*, 450 U.S. 175 (1981). In *Diehr*, the Supreme Court found that "the claims employed a 'well-known' mathematical equation, but it used that equation in a process designed to solve a technological problem in 'conventional industry practice,'" and so was patent eligible. *Alice*, 134 S. Ct. at 2358 (citation omitted). The Supreme Court found "these additional steps transformed the process into an inventive application of the formula." *Mayo*, 132 S. Ct. at 1292. The claims here are akin to those in *Diehr*.

At the other end of the spectrum is *Parker v. Flook*, 437 U.S. 584 (1978). The claims in *Flook* explicitly claimed a number; *i.e.*, "updating the value of an alarm limit" of a process variable involved in petrochemical and oil-refining industries. *Id*. at 586, 589-90. However, the updated value is not used in the claim; it is merely calculated. *Id*. at 585. In contrast, the claims in *Diehr* include a mathematical equation, but then use the results of that equation to operate a rubber-molding press. *Diehr*, 450 U.S. at 186-87. Specifically, where the *Flook* claims attempted to patent a formula to calculate a value, *Diehr* claimed a method that used a calculated value. *Id*. Like *Diehr*, where the result of the equation is used

for "opening the press automatically when a said comparison indicates equivalence," *In re Diehr*, 602 F.2d 982, 983-84 (C.C.P.A. 1979), the claims here effectuate a change based on the results of a calculation and comparison – the automatic modification of quotes that remain in the exchange trading system when "said threshold is exceeded." A104. As construed by the Board, that change is specific: "automatically canceling or revising a price or quantity of at least one of the received specified quotes still available for execution." A7.

In *Diehr*, the claimed process was (1) "constantly determining the temperature … of the mold…[and] providing the computer with the temperature," (2) "repetitively comparing in the computer…said calculation…and said elapsed time," and (3) "opening the press automatically when a said comparison indicates equivalence." *In re Diehr*, 602 F.2d at 983-84. Exactly parallel to the *Diehr* claims, the CBOE claims (1) "determin[e] a risk level and an aggregate risk level associated with said trade" when a quote has been filled, (2) the system then "compar[es] said aggregate risk level with said risk threshold," and (3) when the threshold is exceeded, the system "automatically cancel[s] or revis[es] a price or quantity of at least one of the received specified quotes still available for execution." A7, A104.

The Board, trying to fit a square peg in a round hole, ignored the express claim language and instead characterized the claims as directed to the traditional

concept of risk management. Just as the *Diehr* claims were directed to operating a press and not the Arrhenius equation itself, the CBOE claims are directed to operating a machine, an improved automated exchange trading system, and not to the intermediate risk determination itself. The claims here "appl[y] [a] formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to protect," and therefore "the claim satisfies the requirements of § 101." *Diehr*, 450 U.S. at 192-93.

b) The Claims Are Not Directed to the Abstract Idea of "Risk Management"

The Board erred when it concluded that the claims at issue are directed to the abstract idea of "risk management." *See* A10-11. In an overly simplistic and conclusory fashion, the Board determined that the claimed invention at issue in this case is analogous to the "risk hedging" claims in *Bilski*. A11. The claim in *Bilski*, however, expressly claimed "[a] method for managing the consumption risk costs of a commodity…" *In re Bilski*, 545 F.3d at 949. In short, *Bilski* was an attempt to patent an abstract idea "just like the algorithms at issue in…*Flook*." *Bilski*, 561 U.S. at 611-12. In contrast, the CBOE claims are not directed to a method for managing risk, but rather a method for improving an "automated exchange trading system," to solve a problem unique to and directly caused by electronic trading.

As the specification of the CBOE Patents makes clear, there are "software tools that can analyze stock and option portfolios," and that "[m]arket data is

provided to the software analysis tools and used to evaluate the risk associated with stock and option portfolios." A96. This is *not* what is claimed here. Human market makers continue to calculate risk either mentally or with the help of such software tools and manually revise or cancel quotes as a result, even while working on automated exchange trading systems that implement the patented invention. The claims of the CBOE Patents do not impede the ability of the market makers to manage their risk or implement trading strategies, and do not interfere with any longstanding economic practices. Therefore, there is no risk that the claims will "monopoliz[e]…those tools through the grant of a patent," *Alice*, 134 S. Ct. at 2354, nor will it "'tie up' the use of such tools and thereby 'inhibit future innovation premised upon them.'" *Ass'n for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S. Ct. 2107, 2116 (2013) (citation omitted).

c) CBOE Has Never Suggested Its Claimed Invention Is Abstract

The Board stated that "Patent Owner does not dispute that the '498 patent claims are directed to an abstract idea." A11. This is not correct. The Board relied on a single sentence in CBOE's Patent Owner Response that it "submits that the claims are not merely to an abstract idea, but rather provide a specific application of risk management with many specific, meaningful limitations." A11; A1205. The Board misconstrued this statement to mean that CBOE did not dispute that the patent claims are directed to an abstract idea. A11. To the contrary,

CBOE repeatedly argued that the claims at issue are not directed to an abstract idea. For example, CBOE stated in its Patent Owner Response that "[t]he claims represent non-abstract technological innovations that fall within the traditional scope of patent law." A1219; *see also* A1136-38 ("the challenged claims … are directed to an improvement in automated exchange trading technology); A1248. CBOE simply stated that under any possible characterization of an abstract idea, the claims at issue satisfy *Mayo*/*Alice* step two and contain an inventive concept. *See* n.11, *supra*.

2. The Claims Include an Inventive Concept

The second step of the *Mayo*/*Alice* framework asks "what else is there in the claims" and whether it is "sufficient to transform the nature of the claim" into a patent-eligible application. *Mayo*, 132 S. Ct. at 1297; *Alice*, 134 S. Ct. at 2355. This has become known as the "search for an inventive concept – *i.e.*, an element or combination of elements that is sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the ineligible concept itself." *Alice*, 134 S. Ct. at 2355 (citation omitted).

The CBOE claims include an "inventive concept" distinct from traditional concepts of risk management. The change to electronic exchange trading produced a significant new vulnerability that did not exist with manual open outcry trading.

The claimed improvement eliminates that new vulnerability of electronic trading, and has nothing to do with concepts related to manual open outcry systems.

Specifically, the claimed improvement includes the step of "automatically cancelling or revising a price or quantity of at least one of the received specified quotes still available for execution" when a threshold is exceeded, thereby addressing the new problem created by the industry shift from open outcry to electronic exchanges. *See* A7 (Board's construction of clause [f]). The addition of this novel safeguard to an exchange trading system is "significantly more than a patent upon the ineligible concept itself." *See Alice*, 134 S. Ct. at 2355. As noted above, the Supreme Court has observed that method claims that "purport to improve the functioning of the computer itself" or "effect an improvement in any other technology or technical field," such as automated exchange trading systems, are eligible for a patent. *Id*. at 2359 (emphasis added).

a) Electronic Exchange Systems Required an Improvement to the Functioning of the System Itself

As discussed above, with the automation of exchanges, quotes now apply to individual market makers, with specific sizes, and market makers typically must issue huge numbers of quotes up front that remain open in the system until traded against or removed. Unlike the manual, verbal, face-to-face, and on-demand trading of open outcry, market makers using automated exchange trading systems now do not even know about trades (or thousands of trades) that they have made

until after execution. These changes have significantly altered market maker obligations, and left them vulnerable to countless unwanted trades without their knowledge. This risk did not exist in human open outcry systems, and thus, these claims are irrelevant to them. Electronic trading produced a new risk; the patented invention thwarts that risk.

Thus, the Board erred when it compared the present invention to "a wonderful new risk hedging technique." A21. This is not a new risk hedging technique, but rather a technological improvement to solve a new problem caused by technology. *See DDR Holdings,* 773 F.3d at 1257.

b) The Steps of the Claims are not "Routine and Conventional"

"Simply appending conventional steps, specified at a high level of generality [is] not *enough* to supply an 'inventive concept.'" *Alice*, 134 S. Ct. at 2357 (citation omitted) (emphasis in original). "Computer functions [that] are 'well-understood, routine, conventional activities' previously known in the industry" are also insufficient to transform the claims. *Id*. at 2359. But, the steps of the CBOE claims are not routine and conventional. They are – as the same panel of the Board found in its IPR decisions – new and non-obvious.

In reaching its conclusion, the Board ignored the differences between manual open outcry and automated exchange trading systems. In an open outcry system, market makers might use software analysis tools to calculate risk, but in

such open outcry systems, quotes did not have a pre-determined size, and market makers could not be forced to trade on any particular quote. The human market maker sitting in the pit could decide for himself whether to: (a) make the trade; (b) not make the trade; or (c) make a trade for a limited number of shares. He would think it through, make a decision, and then communicate his decision, along with a size, before he committed to any trade. Therefore, there were no "specified quotes still available for execution" to be canceled or revised – a required CBOE claim limitation. *See* A7. Quotes were only "available" prospectively, if the market maker decided to enter into the trade. And once the trade was entered into, the quote was no longer "available for execution." *Id*. There was certainly no modification of quotes "remaining … in the quote group" (another required limitation) if a risk threshold was exceeded, as such a concept makes no sense in the context of an open outcry exchange.

Additionally, other CBOE claim limitations were not present in a manual, open outcry system. For example, there was no entity in open outcry that would "receiv[e] orders and quotes having quote groups" where "specified ones of said quotes have associated trading parameters comprising a risk threshold" – another claim element. Similarly, there was no "storing each of said orders and quotes when a trade is not generated" (another claim element). Trades occurred only when a broker and market maker verbally reached agreement on the pit floor. It

could not be, therefore, that these claim steps were "routine and conventional" in open outcry systems.

To the extent then-existing automated exchange trading systems could receive orders and quotes and generate a trade, they could not perform any of these required claim limitations:

> determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
>
> comparing said aggregate risk level with said risk threshold; and,
>
> automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded,

as required by claim 1 of the '498 Patent. A104 (emphasis added). The record is devoid of any evidence that performance of these steps was "routine and conventional," because they were not done in open outcry systems or by then-existing trading systems.

The Board's decisions in the related IPR proceedings further illustrate this point. ISE based its IPR petitions on the "best" prior art it had found. A2156-58. The Board then found CBOE's claims patentable over that art because the prior art trading systems lacked the functionality of "determining a risk level and an aggregate risk level associated with said trade." *Int'l Sec. Exch., LLC*, 2015 WL 930271, at *5; *Int'l Sec. Exch., LLC*, 2015 WL 930272, at *5. Without such a

determination, prior art trading systems could not compare that risk level to a risk threshold or "automatically modify" a quote if the threshold was exceeded, as required by the claims.

It was therefore improper for the Board to conclude – without any analysis – that a process that is neither anticipated nor obvious in light the prior art was nevertheless "routine and conventional" for § 101 purposes.

c) The Claims Are a Technological Improvement to a Specialized Machine

The Board improperly determined that the claimed steps could be performed by a general purpose computer. In doing so, the Board disregarded evidence regarding how one of ordinary skill in the art would understand exchange trading systems and misread portions of the CBOE Patents' specification regarding the hardware and software building blocks used to construct an automated exchange trading system. Proper consideration of this evidence shows that an automated exchange trading system is a specialized machine, critical to performance of the claimed steps.

As explained by Dr. Sandholm – whose testimony was the only evidence on this point – the claimed improved trading system requires a significant amount of specially programmed computing technology, and "[t]here are significant hardware and programming efforts to go from an exchange without the claimed method to an exchange with the claimed method." A1537-47 ("[I]t takes several years (and

millions of dollars) to configure and program these servers . . . to allow the network to perform the functions of an automated exchange trading system."). Although it had the opportunity to submit rebuttal testimony in the form of a reply declaration, ISE did not provide any technical expert testimony to the contrary.

None of "generating a trade by matching," "determining a risk level and an aggregate risk level associated with said trade," or "automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said threshold is exceeded," is a "generic computer function[]." Rather, one of ordinary skill in the art would have recognized that a generic computer could not perform any of these functions. A1544-45 ("[A]n automated exchange trading system is a combination of specific, high-power computer equipment programmed in specific ways to deliver the required unique processing capabilities in order to perform the functions of options trading… Such programming requires substantial time and effort, and is not found in the standard functions of a general-purpose computer.").

The Board's statement that "the claimed methods can be performed using known off-the-shelf computer hardware" (A14) is not supported by any technical evidence provided by ISE. Rather, the Board based its determination solely on a misreading of the patent specification. *See id*.

While the patent recognizes that general purpose or specialized computers could be the starting materials needed to create an automated exchange trading

system (A104), which is true of many great inventions like the PC, smartphone, GPS, etc., this recognition is merely that one does not need to start with specialized hardware, as long as the hardware is later specially configured and programmed to implement the modules of the patent. As explained by Dr. Sandholm – and not contradicted by any evidence of record – significant programming and enhancements are required to reconfigure these basic devices to perform the functions of an automated exchange. *See* A1544-45.

The fact that the invention may begin with generic hardware components does not mean that the resultant exchange trading system is not patent eligible. The vast majority of patents use generic components as starting materials (*e.g.*, gears and pulleys); however, it is the inventive modification of these components to create new machines and technologies that is at the core of patentable innovation.

Regardless of the specific system used to implement the claims, the claims employ a calculation "in a process designed to solve a technological problem in conventional industry practice." *Alice*, 134 S. Ct. at 2358 (citation and quotation marks omitted). These claims are "patent eligible because they improve[] an existing technological process, not because they [are] implemented on a computer." *Id.*

d) The Claims Do Not Preempt Risk Management

As discussed previously, it would be impossible for a market maker in either an open outcry or automated system to infringe the present claims. *See* Argument, *supra* at Section II.C.1. Market makers continue to manage their risk and implement their trading strategies unimpeded by the CBOE Patents, just as exchanges continue to implement numerous safeguards and risk management tools outside the scope of the claims.

D. How Else Could CBOE Have Protected Its Invention?

Exchanges should be able to develop (and protect) specific improvements to their trading systems that protect the market and its users as new dangers arise with advancements in technology. With respect to exchanges, transparency is (rightly) federally mandated. Therefore, "trade secrets" are often not an option, and the best way to protect such an invention is through patents. As a policy matter, this should not be discouraged. To the contrary, exchanges should be incentivized to develop new improvements and technological safeguards against the growing threat of cyber-attacks and traders seeking to exploit the vulnerabilities of electronic exchanges and the technology and infrastructure that underlies them.

Finally, § 101, and the creation of CBM review with jurisdiction over § 101 issues is not carte blanche for the Board to eliminate all patents with any connection to financial services or electronic trading. In fact, Senator Schumer,

co-author of the legislation introducing CBM review, explained that "patents to develop novel software tools…widely commercialized and used within the electronic trading industry to implement trading and asset allocation strategies" are not the "target of [the section on CBM review]." 157 Cong. Rec. S5402-02, at S5428 (daily ed. Sept. 8, 2011). Patent holders, like CBOE, that "provide large numbers of American workers with good jobs through the development and commercialization of those patents are not the ones that have created the business method patent problems…and it is not the understanding of Congress that such patents would be reviewed and invalidated under [this] Section." *Id*.

However, since the enactment of the AIA, the Board has instituted CBM review for approximately 85% of claims challenged under § 101, and has rejected 100% of the instituted claims as patent-ineligible.[12] As stated by the Board's Chief Judge James Smith: "If we weren't, in part, doing some 'death squadding,' we would not be doing what the statute calls on us to do."[13] This Court must step in and restrain the Board's use of §101 "lest it swallow all" patent protection to innovations and improvements in the financial industry. *Alice*, 134 S. Ct. at 2354.

[12] Statistics available from the Patent Review Processing System, United States Patent and Trademark Office, https://ptabtrials.uspto.gov (accessed Aug. 12, 2015).

[13] Ryan Davis, *PTAB's "Death Squad" Label Not Totally Off-Base, Chief Says*, Law360 (Aug. 14, 2014).

III. THE BOARD ERRED BY NOT ADDRESSING EVIDENCE THAT WOULD HAVE LED IT TO FIND THE CLAIMS PATENT ELIGIBLE

The Board's decisions in this case suffer from three additional failures.

First, substantial evidence does not support the factual determinations the Board made with respect to: (i) what was "routine and conventional," (ii) the differences between manual open outcry and electronic exchanges, and (iii) whether the invention could be implemented on a general purpose computer.

Second, the Board failed, as far as can be discerned from its decisions, to consider significant evidence provided by CBOE, including an entire declaration, and key admissions from ISE's expert.

Third, the Board did not mention, cite, or even reference its related decision in the IPRs, which found two of the patents valid.

Accordingly, the Board's factual considerations should be set aside. *See* 5 U.S.C. § 706(2)(E). Full consideration of the evidence supports a finding that the claims of the CBOE Patents are eligible under § 101.

A. The Board's Factual Findings Are Not Justified by the Record and the Board Failed to Explicate Its Factual Conclusions

Under the substantial evidence standard, courts have required that "[t]he ALJ must identify the testimony that was not credible, and specify 'what evidence undermines the claimant's complaints.'" *Treichler v. Comm'r of Soc. Sec. Admin.*, 775 F.3d 1090, 1103 (9th Cir. 2014) (citation omitted). This Court has "expressly

held that the Board's opinion must explicate its factual conclusions, enabling us to verify readily whether those conclusions are indeed supported by 'substantial evidence' contained within the record." *In re Gartside*, 203 F.3d at 1314 (finding the "record, when before us, is closed, in that the Board's decision must be justified within the four corners of that record"). Similarly, an "agency must explain its reasoning" "[b]ecause the 'grounds upon which an administrative order must be judged are those upon which the record discloses that its action was based.'" *Treichler*, 775 F.3d at 1102 (citation omitted); *Rozbicki v. Chiang*, 590 Fed. App'x 990, 999 (Fed. Cir. 2014) (vacating and remanding "for the PTAB to provide a more detailed explanation…including a discussion of the expert testimony from both parties"). In this case, the Board has failed to explicate its factual conclusions and its factual findings are unsupported.

B. The Board Erred When It Inconsistently Found the Invention to be "Routine and Conventional" Yet Novel and Non-Obvious

This is a rare case in which both IPR and CBM proceedings were decided at the same time, by the same panel. The same APJ authored all 5 decisions. In the IPR decisions, the Board found the claims to be novel and non-obvious (*see* discussion, *supra* at Section V.B.), yet in the CBM proceedings, the Board also found that the same claims "contemplate using a generic computer to perform well-understood, routine, conventional activities previously known to the industry." A17.

The Board failed to explain in its CBM decision how a process and improved trading system, which it found was new and non-obvious was simultaneously nothing more than "routine and conventional" in the industry. The CBM decision offered no consideration, citation or discussion of the IPR proceedings. The Board owed CBOE, the public, and this Court some explanation as to its facially inconsistent findings.

The issue is not whether it is theoretically possible to find a claim "routine and conventional" under § 101, yet valid under 35 U.S.C. §§ 102 and 103. Such a conclusion is incorrect in this case, as explained in Section II.C.2. above. Rather, under the APA's substantial evidence standard, the panel must offer an explanation of its seemingly contradictory conclusions because its findings regarding the invention being new and not obvious are relevant to, and inconsistent with, its findings of whether the same invention is routine and convention.

In cases like *Bilski* and *Alice* it was clear from the Supreme Court's opinion that the underlying techniques – hedging and escrow, respectively – were well known in the art. Thus, merely adding a general purpose computer did not confer patentability. However, we know that is not the case here because the Board found that the invention was new and not obvious.

C. The Board Erred by Failing to Address Key Evidence

1. The Board Erred When It Failed to Address the Testimony of Market Maker/Inventor Kaminsky

The Board failed to cite – much less discuss – the testimony of CBOE's declarant, Ross Kaminsky. Kaminsky is an inventor of the CBOE Patents, and was the only market maker to provide testimony in this case. Kaminsky's testimony is primarily directed to the differences between open outcry and automated exchanges, the problems posed by then-existing automated exchanges, and how the CBOE patents solved that problem. *See* A1484-1523 (Kaminsky Decl.). Inexplicably, the decisions do not include a single citation to Kaminsky's declaration, let alone a discussion of the probative value of his testimony. Rather, the Board makes factual determinations directly contradicted by Kaminsky's testimony without any explanation or support for its determinations.

Kaminsky's testimony is central to CBOE's arguments and it was improper for the Board to disregard his testimony in full without identifying any "testimony that was not credible." *See Treichler*, 775 F.3d at 1103.

2. The Board Erred by Failing to Address an Admission by ISE's Expert that the Invention "Is a Technological Improvement"

CBOE repeatedly has argued in support of patent eligibility that the present invention is a technological solution to a technological problem. *See, e.g.*, Section IV, *supra*. Under cross-examination, ISE's expert gave testimony that supports

CBOE's argument, admitting that the present invention is a technological innovation:

> Q. Okay. Let's take two exchanges --which are in all respects the same-- but for the fact that one exchange allows for the automatic modification of market makers quotes to protect against unwanted risk to the market makers and the other does not. The former exchange would constitute, in your expert opinion, a significant technological improvement over the latter exchange, correct?
>
> A. I would think that it might be attractive to market makers to trade in the exchange that allowed them to update.
>
> Q. Which you would agree is a significant technological improvement, correct?
>
> A. I would agree is a technological improvement.

A1879-80 (emphasis added). However, the CBM decisions do not discuss, reconcile, or even cite to this admission.

D. The Board's Finding that the Claims May Be Performed on Generic Computers Is Not Supported By Substantial Evidence

The Board based its conclusion of patent ineligibility on its own view that the claimed steps could be performed by a general purpose computer. *See, e.g.*. A13-14. However, this finding is not supported by substantial evidence.

CBOE's expert, Dr. Sandholm, testified as to the sophistication of automated exchange trading systems. *See* A1524-49. Specifically, Dr. Sandholm testified that a generic computer could not perform any of the claimed functions. A1544. ISE elected not to submit a rebuttal declaration addressing the technical aspects of

automated trading systems, and as such, there is no evidence in the record that an "automated exchange trading system" is anything other than a specialized machine.

The Board erred by substituting its own judgment for that of the expert, without contrary evidence from ISE. *Brand v. Miller*, 487 F.3d 862, 869 (Fed. Cir. 2007) ("it is impermissible for the Board to base its factual findings on its expertise, rather than on evidence in the record").

E. At a Minimum, a Remand is Required for the Board to Reconcile its Inconsistent Findings, and so that It Can Address All the Evidence

There can be no questions that the errors discussed above affected the Board's decision. *See In re Chapman*, 595 F.3d 1330, 1339-40 (Fed. Cir. 2010). The Board made findings inconsistent with evidence in the record it never addressed. The Board made findings inconsistent with its own IPR decision. Given the close connection between the above-identified factual determinations and the Board's ultimate conclusions on patent-eligibility, the errors were harmful. CBOE urges this Court to reverse the Board and find that the CBOE Patents cover eligible subject matter. In the alternative, CBOE asks that this Court vacate the Board's CBM decisions and remand for further proceedings.

CONCLUSION

CBOE respectfully requests that the judgment of the Board be reversed and the claims be found patent eligible.

Dated: September 18, 2015

Respectfully submitted,

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ADDENDUM 1

Final Written Decision - 35 U.S.C. § 328(a) and 37 C.F.R. § 42.73, Case CBM2013-00049 (PTAB March 2, 2015) (Paper 53)

A1 – A29

2015-1728, -1729 & -1730

Chicago Board Options Exchange, Incorporated
v.
International Securities Exchange, LLC

Trials@uspto.gov
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Paper No. 53
Filed: March 2, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTERNATIONAL SECURITIES EXCHANGE, LLC,
Petitioner,

v.

CHICAGO BOARD OPTIONS EXCHANGE, INC.,
Patent Owner.

Case CBM2013-00049
Patent 7,356,498 B2

Before JUSTIN T. ARBES, RAMA G. ELLURU, and JAMES B. ARPIN, *Administrative Patent Judges.*

ELLURU, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 328(a) and 37 C.F.R. § 42.73

I. BACKGROUND

Petitioner, International Securities Exchange, LLC, filed a second corrected Petition (Paper 9, "Pet.") requesting review under the transitional program for covered business method patents of claims 1–28 of U.S. Patent No. 7,356,498 B2 (Ex. 1001, "the '498 patent"). Patent Owner, Chicago Board Options Exchange, Inc., filed a Preliminary Response (Paper 16, "Prelim. Resp."). On March 4, 2014, pursuant to 35 U.S.C. § 324, we instituted this trial as to claims 1–28 on one ground of unpatentability, 35 U.S.C. § 101 (Paper 17, "Dec. to Inst.").

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 26, "PO Resp."), a First Supplemental Response (Paper 39, "PO First Supp. Resp."), a Second Supplemental Response (Paper 51, "PO Second Supp. Resp."), a Motion to Amend (Paper 25, "Mot."), and a Reply in support of its Motion (Paper 42, "PO Reply"). Petitioner filed a Reply (Paper 36, "Pet. Reply") to Patent Owner's Response, a First Supplemental Reply (Paper 41, "Pet. First Supp. Reply"), a Second Supplemental Reply (Paper 52, "Pet. Second Supp. Reply"), and an Opposition to Patent Owner's Motion to Amend (Paper 37, "Opp.").

An oral hearing was held on August 22, 2014, and a transcript of the hearing is included in the record (Paper 49, "Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 328(a) and 37 C.F.R. § 42.73.

For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–28 of the '498 patent are unpatentable.

A. The '498 Patent

The '498 patent, titled "Automated Trading Exchange System Having Integrated Quote Risk Monitoring and Integrated Quote Modification Services," issued on April 8, 2008, based on U.S. Patent Application No. 09/475,534 ("the '534 application"), filed on December 30, 1999.[1]

The '498 patent relates to automated trading systems for option contracts ("options"). Ex. 1001, 1:8–12, Abstract. Specifically, the claimed invention is directed to methods for managing the risk of a maker of an options market in an automated trading system. *Id.* at 1:8–12.

Options are traded publicly on exchanges. *Id.* at 1:17. Each option covers certain rights to buy or sell an underlying security at a fixed price for a specified period of time. *Id.* at 1:18–21. The potential loss to the buyer of an option is no greater than the initial premium paid for the option, regardless of the performance of the underlying security. *Id.* at 1:27–29. On the contrary, in exchange for the premium, the seller of the option ("the market-maker") assumes the risk of being assigned the obligation to buy or sell the underlying security, according to the option terms, if the contract is exercised. *Id.* at 1:30–34. Thus, writing options may entail large risks to the market-maker. *Id.* at 1:34–35.

[1] U.S. Patent Application No. 12/035,996 ("the '996 application") is a continuation of the '534 application, and issued as U.S. Patent No. 7,980,457 B2 ("the '457 patent"). U.S. Patent Application No. 13/178,289 ("the '289 application") is a continuation of the '996 application and issued as U.S. Patent No. 8,266,044 B2 ("the '044 patent"). The '498 patent also is the subject of IPR2014-00097. The '457 patent is the subject of CBM2013-00050 and IPR2014-00098. The '044 patent is the subject of CBM2013-00051. Final Written Decisions are entered in these cases concurrently with this Decision.

Many option trading systems utilize an "open outcry" method. *Id.* at 1:43–44. In such systems, market-makers are required to make a two-sided market by providing an order and an offer quote. *Id.* at 1:44–46. In a non-automated open outcry system, a market-maker communicates verbally with traders indicating their willingness to buy and sell various quantities of securities. *Id.* at 1:46–49. Because a market-maker in such systems has personal control over the types and number of options traded, the market-maker can manage risk associated with his or her options portfolio. *Id.* at 1:49–53. A market-maker manages risk by adjusting quotes for options to favor trades that tend to hedge against unwanted risk. *Id.* at 1:52–55.

The '498 patent Specification states that an automated trading environment already was known in the art. *Id.* at 1:56–58, 61–65. An automated, computer-based trading system typically records quotes and automatically matches them with orders that enter the system. *Id.* at 1:58–61. One disadvantage of known automated trading systems is that the systems execute trades so rapidly that a market-maker may be unable to withdraw or modify his quotes in a timely manner. *Id.* at 1:61–2:5. Software tools that assess trading option portfolio risk and recommend quote modifications also were known. *Id.* at 2:6–12. An automated trading system, however, processes transactions in the order received. *Id.* at 2:16–19. Thus, even if a market-maker uses such software tools to modify quotes, those tools may be unable to act in time, given the speed at which the automated trading exchange system executes orders. *Id.* at 2:12–16. For example, an automated trading exchange may have a message queue containing additional orders that must be processed before the automated exchange receives and processes the market-maker's quote modification

request. *Id.* at 2:19–23. These known, automated trading exchange systems, therefore, limit a market-maker's ability to manage risk. *Id.* at 2:24–32. The '498 patent Specification recognizes the need for a method that automatically modifies quotes under certain trading conditions in an automated trading exchange system. *Id.* at 2:33–35.

The invention of the '498 patent is directed to methods for modifying quotes in an automated exchange trading system, where the system provides integrated quote risk monitoring and quote modification services. *Id.* at 2:39–41. Thus, one aspect of the invention is an apparatus that implements the method using a computer having memory, a processor, and a communication port. *Id.* at 2:41–44.

The computer receives orders and quotes, wherein a quote has associated trading parameters, such as a risk threshold. *Id.* at 2:44–47. The computer then may generate a trade by matching the received orders and quotes to previously received orders and quotes. *Id.* at 2:54–56. If a trade is not generated, the computer stores each of the received orders and quotes. *Id.* at 2:56–57. The computer determines whether a market-maker's quote has been filled as a result of the generated trade, and, if so, determines a risk level and aggregate risk level associated with the trade. *Id.* at 2:57–61. The computer then compares the aggregate risk level with the market-maker's risk threshold for a quote; if the threshold is exceeded, the computer automatically modifies at least one of the market-maker's remaining quotes. *Id.* at 2:61–64.

B. Illustrative Claim

Of the challenged claims, claims 1 and 8 are independent claims. Claim 1 of the '498 patent, reproduced below, is illustrative of the challenged claims.

> 1. A method of modifying quotes in an automated exchange trading system comprising the steps of:
>
> receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;
>
> generating a trade by matching said received orders and quotes to previously received orders and quotes;
>
> storing each of said orders and quotes when a trade is not generated;
>
> determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
>
> comparing said aggregate risk level with said risk threshold; and, automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded.

II. ANALYSIS

A. Claim Construction

Consistent with the statute and the legislative history of the AIA,[2] the Patent Trial and Appeal Board ("Board") interprets claims of an unexpired patent using the broadest reasonable construction in light of the specification of the challenged patent. *See Office Patent Trial Practice Guide*, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012); 37 C.F.R. § 42.300(b); *In re Cuozzo Speed Techs., LLC*, No. 2014-1301, 2015 WL 448667, at *5–8 (Fed. Cir. Feb. 4, 2015). There is a "'heavy presumption' that a claim term carries its

[2] Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) ("AIA").

ordinary and customary meaning." *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (internal citation omitted). In our Decision to Institute, we determined that our analysis did not require an express interpretation of any term. Dec. to Inst. 7. The parties do not contest that determination. *See, e.g.*, Tr. 61:6–17, 102:12–103:18. We likewise determine that, for purposes of this Final Written Decision, our analysis does not require us to provide an express interpretation for any claim term. Nevertheless, to the extent any claim construction is applicable, that construction is consistent with the constructions presented in the contemporaneously issued Decisions in related *inter partes* reviews IPR2014-00097 and IPR2014-00098. Those constructions are as follows.

Claim Term	Construction
"risk level . . . associated with said trade"	"a calculated, measured, or otherwise obtained value of exposure to the possibility of loss related to said trade"
"aggregate risk level associated with said trade"	"a calculated, measured, or otherwise obtained aggregate value (e.g., combination, sum, weighed sum, difference) of exposure to the possibility of loss related to such trade"
"automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded"	"automatically cancelling or revising a price or quantity of at least one of the received specified quotes still available for execution"

B. Claims 1–28 of the '498 Patent are Unpatentable as Directed to Non-Statutory Subject Matter

Petitioner challenges claims 1–28 of the '498 patent under 35 U.S.C. § 101, as directed to patent-ineligible subject matter. Pet. 24–33. Patent

Owner maintains that its claims are directed to patent-eligible processes because, for example, the claims include specific meaningful limitations that must be performed on programmed computers, electronic exchanges that incorporate the claimed features were an improvement over systems without them, the claimed steps cannot be performed manually, the claims are not directed to similar or substantially similar methods of managing risk market-makers previously used, and the claims do not preempt hedging risk management techniques. PO Resp. 35–79.

1. 35 U.S.C. § 101 Patentability Analysis

Under 35 U.S.C. § 101, we must first identify whether an invention fits within one of the four statutorily provided categories of patent-eligibility: "processes, machines, manufactures, and compositions of matter." *Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 713–714 (Fed. Cir. 2014). Here, each of the challenged claims recites a "process," e.g., a method, under § 101.

Section 101 of the Patent Act defines subject matter eligibility, and the Supreme Court has "long held that this provision contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable." *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S.Ct. 2347, 2354 (2014) (citing *Assoc. for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S.Ct. 2107, 2116 (2013) (internal quotation marks and brackets omitted)). "The 'abstract ideas' category embodies the longstanding rule that '[a]n idea of itself is not patentable.'" *Alice Corp.*, 134 S.Ct. at 2355 (citing *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972) (quotations omitted)).

In *Alice Corp.*, the Supreme Court emphasized the "*Mayo* framework," which provides "a framework for distinguishing patents that

claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts." *Id.* (citing *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S.Ct. 1289, 1298 (2012)). Under the *Mayo* framework, "[w]e must first determine whether the claims at issue are directed to a patent-ineligible concept." *Id.* Next, "we consider the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Id.* (citing *Mayo*, 132 S.Ct. at 1297–98). To be patentable, a claim must do more than simply state the law of nature or abstract idea and add the words "apply it." *Mayo*, 132 S.Ct. at 1294; *see Benson*, 409 U.S. at 67. Furthermore, "the mere recitation of a generic computer cannot transform a patent-ineligible abstract idea into a patent-eligible invention." *Alice Corp.*, 134 S.Ct. at 2358; *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1256 (Fed. Cir. 2014) ("And after *Alice*, there can remain no doubt: recitation of generic computer limitations does not make an otherwise ineligible claim patent-eligible.") (citation omitted). "Thus, if a patent's recitation of a computer amounts to a mere instruction to 'implemen[t]' an abstract idea 'on . . . a computer,' that addition cannot impart patent eligibility." *Alice Corp.*, 134 S.Ct. at 2358 (internal citation omitted).

A challenged claim must incorporate sufficient meaningful limitations to ensure that it claims more than just an abstract idea and is not merely a "'drafting effort designed to monopolize the [abstract idea].'" *Id.* at 2357 (quoting *Mayo*, 132 S.Ct. at 1297). "Simply appending conventional steps, specified at a high level of generality," is not "*enough*" for patent eligibility. *Id.* (quoting *Mayo*, 132 S.Ct. at 1292). Further, the "prohibition against

patenting abstract ideas 'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment' or adding 'insignificant postsolution activity.'" *Bilski v. Kappos*, 561 U.S. 593, 610–11 (2010) (quoting *Diamond v. Diehr*, 450 U.S. 175, 191–92 (1981)).

Thus, we analyze the claims to determine whether the claims embody a patent-eligible application of an abstract idea or are directed merely to nothing more than the abstract idea itself.

2. Claims 1–28 of the '498 Patent Are Unpatentably Abstract

In accordance with the Supreme Court's framework, we must first "determine whether the claims at issue are directed to" an abstract idea. *Alice Corp.*, 134 S.Ct. at 2355. The patents at issue in *Alice* claimed "a method of exchanging financial obligations between two parties using a third-party intermediary to mitigate settlement risk." *Id.* at 2356. Like the method of hedging risk in *Bilski*, 130 S.Ct. at 3240—which the Court deemed "a method of organizing human activity"—*Alice*'s "concept of intermediated settlement" was held to be "'a fundamental economic practice long prevalent in our system of commerce.'" *Alice Corp.*, 134 S.Ct. at 2356 (citations omitted). With respect to the first step of the "*Mayo* framework," the Supreme Court concluded in *Alice Corp.* that "there is no meaningful distinction between the concept of risk hedging in *Bilski* and the concept of intermediated settlement" in *Alice Corp.* and that "[b]oth are squarely within the realm of 'abstract ideas' as we have used that term." *Id.* at 2357.

Here, Petitioner argues that Patent Owner's claims are directed to the abstract concept of "managing trading risk — expressed in the claims as automatically modifying pending quotes so that market makers do not accumulate unacceptable amounts of risk," similar to the "hedging risk"

claims in *Bilski*. Pet. 26; Pet. Reply 1, 3–4. Patent Owner does not dispute that the '498 patent claims are directed to an abstract idea. *See* PO Resp. 41 ("Patent Owner respectfully submits that the claims are not *merely* to an abstract idea, but rather provide a specific application of risk management with many specific, meaningful limitations." (emphasis added)); Ex. 1001, 1:8–12. Similar to the concept of intermediated settlement in *Alice Corp.* and the concept of risk hedging in *Bilski*, we conclude that the concept of managing trading risk ("risk management") is an economic practice long prevalent in our system of commerce and squarely within the realm of abstract ideas. As the '498 patent itself explains, in the prior art "open outcry" exchanges, market-makers adjusted their trading strategies in order to manage their exposure, or risk, associated with their holdings by adjusting their quotes to favor trades that would tend to hedge away unwanted exposure. Ex. 1001, 1:42–55. Furthermore, the claims recite, for example, "receiving orders and quotes," "generating a trade," "determining a risk level and an aggregate risk level associated with said trade," "comparing said aggregate risk level" with a risk threshold, and "automatically modifying" one of the remaining quotes if the threshold is exceeded (claim 1). Accordingly, we analyze the '498 patent claims to determine whether they incorporate sufficient meaningful limitations to ensure that the claims are more than just an abstract idea. *Mayo*, 132 S.Ct. at 1297.

3. Claims 1–28 of the '498 Patent Are Not Meaningfully Limited Under 35 U.S.C. § 101

Step two of the Supreme Court's "*Mayo* framework" requires that we consider the elements of the claim and determine whether there is "an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the

[ineligible concept] itself.'" *Alice Corp.*, 134 S.Ct. at 2355 (quoting *Mayo*, 132 S.Ct. at 1294).

The relevant inquiry here is whether "additional substantive limitations . . . narrow, confine, or otherwise tie down the claim so that, in practical terms, it does not cover the full abstract idea itself." *Accenture Global Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1344–45 (Fed. Cir. 2013) (internal quotations and citation omitted). As we noted above, the Supreme Court in *Alice Corp.* cautioned that merely limiting the use of an abstract idea "to a particular technological environment" or implementing the abstract idea on a "wholly generic computer" is not sufficient as an additional feature to provide "practical assurance that the process is more than a drafting effort designed to monopolize the [abstract idea] itself." *Alice Corp.*, 134 S.Ct. at 2358 (citations omitted).

Patent Owner argues that the challenged independent claims "do not merely incorporate a general purpose computer to perform standard computing functions" (PO Resp. 55), but rather require "specific programming in exchange trading system computers" (*id.* at 45). Patent Owner acknowledges that "[w]hile the specific hardware and software modules that interact to perform each of the claimed steps are not *expressly* recited in the claims, the need for involved specific electronic interactions between computer systems over a computer network are plainly present in the claims." *Id.* In support, Patent Owner refers extensively to the Declaration of Dr. Tuomas Sandholm (Ex. 2017). *See e.g.*, *id.* at 46, 56, 63 (citing Ex. 2017). Petitioner disagrees and argues that the claims "do nothing but 'apply' an abstract idea of risk management using generic functions of a generic computer." Pet. Reply 9; *see CyberSource Corp. v.*

Retail Decisions, Inc., 654 F.3d 1366, 1373 (Fed. Cir. 2011) (Section 101 does not embrace a process defined by using a computer to perform a series of mental steps). We are persuaded by Petitioner's argument.

The challenged claims do not require any specialized hardware. As Petitioner contends, the challenged independent claims do not recite any computer-related limitations, such as a computer, processing unit, etc., and the term "automated exchange trading system" only appears in the preambles as the environment where the claimed method is performed. Pet. Reply 2. "[A] preamble does not limit claim scope if it 'merely states the purpose or intended use of an invention.'" *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344, 1351(Fed. Cir. 2014) (affirming a finding that the recitation of "in a digital image reproduction system" in the preamble of the claims did not limit the claims and that the claims were directed to a patent ineligible abstract idea) (quoting *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 952 (Fed. Cir. 2006)). Here, the recitation "in an automated exchange trading system" in the preamble of claims 1 and 8 merely states the intended use of the claimed invention and does not provide any antecedent basis for limitations in the body of the claim. *Catalina Mktg. Int'l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002) (preamble is not limiting "where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention") (quotation omitted). Therefore, we determine that the recitation of "automated exchange trading system" in the preambles of claims 1 and 8 does not meaningfully limit the claims.

Further, even if the term was limiting, the '498 patent Specification discloses that the claimed methods can be performed by a generic purpose

computer in a generic programming and processing environment. For example, the '498 patent Specification states: "In accordance with a first aspect of the invention, an apparatus is implemented using at least one computer, having memory, a processor, and a communication port." Ex. 1001, 2:41–44. The Specification also makes clear that "[v]arious types of *general purpose* or specialized computer apparatus or computing device may be used with or perform operations in accordance with the teachings described herein." *Id.* at 17:35–38 (emphasis added). The '498 patent Specification likewise explains that "system 100 . . . includes a plurality of computers, which may be *one or more* work-stations, servers, mainframes, or other computer hardware platforms that provides sufficient resources to meet the desired trading volume and desired transaction-processing rate." *Id.* at 3:22–28 (emphasis added). Thus, the Specification indicates that the automated trading system can be built using a general purpose computer and that the complexity of the system depends only on the volume and rate of trading desired.

Furthermore, the Specification explains that the claimed methods can be performed using known off-the-shelf computer hardware. For example, the Specification states that preferable servers are off-the-shelf "SUN Enterprise™" or "Starfire™" servers. *Id.* at 3:34–37; Tr. 37:13–17. Our review of the patent does not indicate that specialized computer hardware is necessary to implement the claimed methods, similar to the claims at issue in *Alice Corp.* *See Alice Corp.*, 134 S.Ct. at 2360 (determining that the hardware recited in the claims was "purely functional and generic," and did not "offer[] a meaningful limitation beyond generally linking the use of the

[method] to a particular technological environment, that is, implementation via computers") (citations and internal quotation marks omitted).

Patent Owner refers extensively to the declaration of its witness, Dr. Sandholm, in support of its position that the claimed methods require specialized and customized hardware and software. PO Resp. 55–64 (citing Ex. 2017 ¶¶ 25–36, 38–39, 41, 44). We do not find Dr. Sandholm's testimony persuasive, however, because it generally relates to commercial embodiments and is not supported by the '498 patent Specification. *See, e.g.*, Ex. 2017 ¶ 26. For example, Dr. Sandholm states that "[a]utomated exchange trading systems include extremely large server networks with extensive processing capabilities" (Ex. 2017 ¶ 25), but the claims do not require any particular network size or extent of processing capability. Further, the '498 patent Specification explains otherwise. According to the Specification, the preferred embodiment of the invention "includes a plurality of computers, which may be *one or more* work-stations, servers, mainframes, or other computer hardware platforms that provide sufficient resources to meet the desired trading volume and desired transaction-processing rate." Ex. 1001, 3:20–28 (emphasis added), 3:28–37.

Patent Owner also argues that, although the '498 patent Specification recognizes that generic hardware can provide the starting materials needed to implement the claimed methods, the hardware must be programmed specifically to perform the claimed methods. PO Resp. 77–78. The Supreme Court, however, has stated expressly that simply executing an abstract concept on a computer does not render a computer "specialized," nor does it automatically transform a patent-ineligible claim into a patent-eligible one. *See Alice Corp.*, 134 S.Ct. at 2358 ("[T]he mere recitation of a

generic computer cannot transform a patent-ineligible abstract idea into a patent-eligible invention. . . . Given the ubiquity of computers, wholly generic computer implementation is not generally the sort of additional featur[e] that provides any practical assurance that the process is more than a drafting effort designed to monopolize the [abstract idea] itself.") (citations and quotation marks omitted); *Bancorp Servs., L.L.C. v. Sun Life Assurance Co.*, 687 F.3d 1266, 1280 (Fed. Cir. 2012). Consequently, we determine that the challenged claims' purported use of a generic computer, programmed to perform the steps of the methods, does not confer patent eligibility, similar to the claims at issue in *Alice Corp*. *See Dealertrack, Inc. v. Huber*, 674 F.3d 1315, 1334 (Fed. Cir. 2012) ("In considering patent eligibility under § 101, one must focus on the claims.").

Patent Owner further argues that the challenged claims include many steps that define the relationship of the various limitations and how the claimed processes are accomplished within the automated exchange, demonstrating that those claims are directed to an application of an abstract idea. PO Resp. 42–49. Patent Owner emphasizes that the claims require at least 13 specific steps and sub-steps. *Id.* at 44. Patent Owner notes, for example, the claims are limited to an "'automated exchange trading system,' wherein a 'risk threshold' is associated with quotes and used by the exchange trading system to 'automatically modify[] at least one of the remaining [quotes] if said threshold is exceeded.'" PO First Supp. Resp. 3; PO Resp. 42, 46. Patent Owner contends that "there was nothing routine or conventional about an exchange trading system adapted to determine an aggregate risk level, compare that risk level with a risk threshold, and then

automatically modify one or more quotes." PO Resp. 47. We are not persuaded by Patent Owner's argument.

The claims contemplate using a generic computer to perform "'well-understood, routine, conventional activit[ies]' previously known to the industry." *Alice Corp.*, 134 S.Ct. at 2359 (quoting *Mayo*, 132 S.Ct. at 1294); *see Mayo*, 132 S.Ct. at 1300 ("simply appending conventional steps, specified at a high level of generality, to laws of nature, natural phenomena, and abstract ideas cannot make those laws, phenomena, and ideas patentable"). The '498 patent explains that, in the known open outcry method of trading, market-makers had personal control over the types and number of contracts traded, and could "adjust their trading strategies" as their positions changed. Ex. 1001, 1:43–52. Thus, they managed their exposure, or risk, associated with their holdings by "adjusting their quotes" to favor trades that would tend to hedge away unwanted exposure. *Id.* at 1:52–55. The '498 patent Specification also recognizes that software analysis tools were available in the prior art to evaluate the "risk associated with stock and option portfolios." *Id.* at 2:6–12. That it was well known to manage trading risk is supported by the testimony of Dr. Maureen O'Hara, Petitioner's witness. Ex. 1004 ¶ 45 (stating that the challenged claimed methods of claims 1 and 8 are "exactly the same method of managing risk that market makers have been performing manually for years prior to the December 1999 filing date of the '498 patent . . . selectively accounting for past trades and current holdings and/or evaluating greek values") (internal footnote omitted). Also, the claimed "risk threshold" of claims 1 and 8 is recited at a high level of generality, and as Petitioner argues, emulates the personal behavior and risk tolerance level of a market-maker with respect to

a type of risk. Pet. Reply 5, 7. Lastly, there is no dispute that the prior art included "automated and computer-based trading system[s]." Ex. 1001, 1:59–60. The claimed methods integrate an automated exchange trading system, already known in the art, with methods that mitigate the risks of a market-maker, also already known in the art. *Id.* at 2:39–41. In sum, the claims amount to nothing more than instructions to apply previously known methods of electronic trading and trade risk management using a generic computer to perform generic computer functions—calculating a risk and determining if that risk exceeds a threshold, and, if so, automatically modifying a quote. *See Alice Corp.*, 134 S.Ct. at 2359.

Moreover, we agree with Petitioner that the challenged claims are patent ineligible because the claims "do nothing more than automate an abstract and mental risk management technique used by market makers in open outcry exchanges for decades." Pet. Reply 4 (citing *Bancorp*, 687 F.3d at 1279 ("[u]sing a computer to accelerate an ineligible mental process does not make that process patent-eligible")). As discussed above, in the prior art outcry options trading systems, market-makers determined and hedged their risks mentally. Ex. 1001, 1:42–55; Ex. 1004 ¶ 45; Ex. 1005, 244:24–245:20. We do not find persuasive Patent Owner's arguments that the claimed methods cannot be performed manually because a human "cannot perform the functions of an exchange trading system," and that the claims include limitations that "must be performed on the exchange-side." PO Resp. 72 (emphasis omitted). Patent Owner's argument that a human cannot handle millions, or hundreds of millions, of orders and quotes each day misses the point. *See* Tr. 69:22–73:13. The claims are not limited to a certain quantity of trading, and the claimed invention's ability to handle a large amount of

orders and quotes is the function of a generic computer. Also, reciting that the claimed steps be performed in an "automated exchange trading system," a system that was indisputably known in the art, and which the patent makes clear can be a generic computer system, does not confer patent eligibility. *See Mayo*, 132 S.Ct. at 1300 (simply appending conventional steps, specified at a high level of generality, to abstract ideas cannot make those ideas patent eligible); Tr. 59:8–61:7 (Patent Owner arguing that we need not define the claim term "automated exchange trading system" precisely).

Relying on the Supreme Court's decision in *Alice Corp.*, Patent Owner argues that the claimed invention is patent eligible because it effects an improvement in the technological area of automated exchange trading systems. *See*, *e.g.*, PO Resp. 51; PO Second Supp. Resp. 1–2; Tr. 44:16–46:12, 47:20–23, 48:22–50:6, 55: 13–56:2, 60:25–61:2; *see Alice Corp.*, 134 S.Ct. at 2359 (distinguishing patent ineligible method claims at issue from claims that "effect an improvement in any other technology or technical field"). Patent Owner contends that the claimed invention solves a new risk posed by electronic trading systems that was not present in prior art open outcry trading systems. *See* Tr. 105:15–16 (Petitioner agreeing that automated exchanges are a technical field). Patent Owner refers to the patent to explain the new risk posed by automated trading systems. PO Resp. 70.

The '498 patent Specification explains that with computerized trading systems and increased communication speeds, the speed and rapidity of trades may exceed the market-maker's ability to adapt his or her position, resulting in an unacceptable risk being assumed by a market-maker. Ex. 1001, 1:56–2:3. "That is, the trades may occur so rapidly that the market-

maker is unable to withdraw or modify his quotes in a timely manner." *Id.* at 2:3–5; Tr. 58:23–25 (Patent Owner arguing that "when you say an automated trading system, it means something that allows for . . . automated, fast, fast trading"); Tr. 72:16–23 (Patent Owner stating that in an automated trading system, quotes can get satisfied "before the market maker even has the opportunity to know that it is going on," so the market-maker "doesn't have the chance to do any calculations"). Thus, Patent Owner contends that an automated exchange trading system that incorporates the claimed features is an "improvement over exchange trading systems without them." PO Resp. 51. We determine that the invention, even as characterized by Patent Owner, does not fall within the scope of patent eligible subject matter as described by the Supreme Court.

The "new risk" described by Patent Owner is the result of automated trading. *See* Tr. 79:10–12. The claimed invention solves the problem by automating risk management, i.e., "automatically" modifying quotes. *See* PO Resp. 71 (Patent Owner emphasizes that the present invention automatically modifies quotes). Whereas in the open outcry system, the market-maker was aware of each trade and could make a decision about the trade, in the claimed invention, the computer is aware of each trade that takes place and makes the risk calculation based on those trades, automatically modifying quotes to protect the trader against a risk which did not exist in the open outcry system. Tr. 73:4–20. The function of "automatically" modifying quotes, however, is the result of integrating risk calculation and quote modification into an automated trading exchange system. That integration allows the computer to make quote modifications at a faster pace. In other words, "it is the [automation of the abstract idea of

risk management] that is 'integral to [the] claims at issue,' not the computer machinery that may be used to accomplish it." *See Bancorp. Servs.*, 687 F.3d at 1279 (citation omitted). As Petitioner argues, "[e]ven if [Patent Owner] came up with a wonderful new risk hedging technique, it is still an abstract concept." Tr. 23:22–24.

In further support of its position that the claims lack a meaningful limitation, Petitioner maintains that the claims preempt all practical uses of the abstract idea of the known risk management technique. Pet. Reply 3; *see also* Pet. Second Supp. Reply 1–2 (contending that the recent *Ultramercial* decision makes it clear that Patent Owner's arguments regarding pre-emption "are not a substitute for the proper two-part test under *Alice*"). Patent Owner disagrees, maintaining instead that the challenged claims do not preempt the "entire field" of managing trading risk. PO Resp. 74. Specifically, Patent Owner argues that the claims cover only "specific applications of this idea," and do not preempt the entire idea of managing trading risk. *Id.* at 75; PO First Supp. Resp. 3. In this vein, Patent Owner contends that the independent and dependent claims should not rise and fall together. PO First Supp. Resp. 4. Specifically, Patent Owner contends that dependent claims 17–19 "are directed to *alternative* methods for modifying quotes." *Id.* at 4–5. Thus, argues Patent Owner, "if one could *either* modify by cancelling (claim 17) *or* by revising bid and offer values (claim 19), neither 'pre-empt[s] all practical uses.'" *Id.* at 5. Patent Owner's argument is unpersuasive.

As Petitioner argues, the issue is whether the claims preempt the abstract idea of risk management "that is claimed." Pet. First Supp. Reply 2 (emphasis omitted). The abstract idea of the dependent claims is not only

risk management in general, but also the specific type of risk management claimed in each claim. *Id.* Furthermore, limiting an abstract idea to a specific field of use or adding token post-solution activity does not make an abstract idea patentable. *Diehr*, 450 U.S. at 191–92; *Parker v. Flook*, 437 U.S. 584, 590 (1978) ("[t]he notion that post-solution activity, no matter how conventional or obvious in itself, can transform an unpatentable principle into a patentable process exalts form over substance"). We further agree with Petitioner (Pet. First Supp. Reply 3–4) that the dependent claims add conventional and/or token post-solution activity to the abstract idea of risk management claimed in the independent claims. For example, the dependent claims identified by Patent Owner in its Supplemental Response limit the claimed step of "automatically modifying" a quote to "canceling" the quote (claim 17), "reducing the quantity associated" with the quote (claim 18), or "revising at least one of the bid and offer values" of the quote (claim 19). These limitations are recited at a high level of generality. Therefore, we determine that the limitations of the dependent claims do not meaningfully limit the claims beyond the claimed abstract idea of risk management, and, in practical terms, preempt the same risk management idea of the independent claims.

For the foregoing reasons, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the challenged claims are directed to patent-ineligible subject matter under § 101.

C. 35 U.S.C. § 101 is a Condition of Unpatentability

Lastly, Patent Owner maintains that 35 U.S.C. § 101 is not a proper ground for covered business method patent review. PO Resp. 79–80. We

addressed this issue in our Decision to Institute. Dec. to Inst. 13–15. We adhere to that determination.

The Supreme Court has recognized § 101 as a condition for patentability. *See, e.g.*, *Mayo*, 132 S.Ct. at 1305 (addressing invalidity under § 101 when it was raised as a defense to an infringement claim); *Graham v. John Deere Co.*, 383 U.S. 1, 12 (1966) (stating that the 1952 Patent Act "sets out the *conditions of patentability* in three sections" (emphasis added), citing 35 U.S.C. §§ 101, 102, and 103). The Federal Circuit also has recognized that § 101 *is* a condition for patentability that can be raised as an affirmative defense under 35 U.S.C. § 282(b)(2). For example, in *Dealertrack*, the majority rejected the dissent's contention that § 101 is not a "condition for patentability," stating that "the 'defenses provided in the statute,' § 282, include not only the 'conditions of patentability' in §§ 102 and 103, but also those in § 101." 674 F.3d at 1330 n.3 (citing *Aristocrat Techs. Austl. PTY Ltd. v. Int'l Game Tech.*, 543 F.3d 657, 661 (Fed. Cir. 2008) ("It has long been understood that the Patent Act sets out the *conditions for patentability* in three sections: sections 101, 102, and 103.") (emphasis added) (citations omitted))). In addition, the Board's consideration of § 101 challenges in covered business method patent reviews also is consistent with the legislative history of the AIA. *See SAP Am., Inc. v. Versata Dev. Grp., Inc.*, Case CBM2012-00001, slip op. at 32–35 (PTAB Jan. 9, 2013) (Paper 36) (discussing the legislative history of the AIA as it relates to covered business method patent reviews covering § 101 challenges).

D. Contingent Motion to Amend Independent Claims 1 and 8 is Denied

Because we determine that claims 1–28 are unpatentable, we turn to Patent Owner's contingent request to enter proposed substitute independent

claims 29 and 30 as replacements for original independent claims 1 and 8, respectively. Mot. 1–2. Proposed independent claims 29 and 30 are reproduced below with underlining to indicate additions relative to original claims 1 and 8, respectively:

> 29. A computer-implemented method of modifying quotes in an automated exchange trading system comprising the steps of:
>
> at least one server receiving, from one or more client servers over a communication network, orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;
>
> the at least one server generating a trade by matching said received orders and quotes to previously received orders and quotes;
>
> the at least one server storing each of said orders and quotes when a trade is not generated;
>
> the at least one server determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
>
> the at least one server comparing said aggregate risk level with said risk threshold; and,
>
> the at least one server automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded.
>
> 30. A computer-implemented method of modifying quotes in an automated exchange trading system that receives orders and quotes from remote computers, matches the orders and quotes to generate trades, and stores orders and quotes that are unmatched, comprising the steps of:
>
> at least one server receiving, from one or more client servers, trading parameters comprising a risk threshold;

> the at least one server associating said trading parameters with specified ones of received quotes;
>
> the at least one server determining whether a quote having associated trading parameters has been filled as a result of a generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
>
> the at least one server comparing said aggregate risk level with said risk threshold; and,
>
> the at least one server automatically modifying at least one of the specified ones of received quotes if said threshold is exceeded.

Id.

A covered business method patent review is not a patent examination proceeding or a patent reexamination proceeding. A proposed substitute claim, in a motion to amend, is not entered automatically and then examined. If a patent owner's motion to amend is granted, the claim will be added directly to the patent, *without examination*. Therefore, we enter proposed amended claims only upon a showing by the patent owner that the amended claims are patentable. *See Idle Free Sys., Inc. v. Bergstrom, Inc.*, Case IPR2012-00027, slip op. at 33 (PTAB Jan. 7, 2014) (Paper 66); *Volusion, Inc. v. Versata Software, Inc.*, Case CBM2013-00017, slip op. at 2–3 (PTAB Dec. 30, 2013) (Paper 19) (*Idle Free's* guidance relating to IPRs applies to CBMs).

Patent Owner as movant bears the burden to demonstrate patentability and compliance with 37 C.F.R. § 42.221. Patent Owner contends that the proposed substitute claims are supported by the disclosure in the '534 application (Ex. 2023), from which the '498 patent issued. Mot. 3–6. Patent Owner states that the proposed substitute claims address the sole ground upon which trial was instituted, patent subject matter eligibility

under § 101. *Id.* at 7. In support of its argument, Patent Owner essentially makes the same arguments it made with respect to the original claims of the '498 patent. *Id.* at 7–8; PO Reply 1–4. For example, Patent Owner argues that the claimed methods must be performed in an "automated exchange," a specific computer system (PO Reply 1–3), the claimed method was not performed mentally by the market-maker in the prior art (*id.* at 2), and the claims are limited to a specific application of performing risk management (*id.* at 2).

Patent Owner characterizes proposed independent claims 29 and 30 as reciting at least one server receiving orders, quotes, or trading parameters from one or more client servers over a communication network,[3] and that each of the method steps is performed by the at least one server. Mot. 7–8. Thus, Patent Owner maintains that the claims "do not merely use a generic computer to perform or accelerate a mental process." *Id.* at 8. Petitioner opposes the Motion to Amend arguing that the claims do not recite patent eligible subject matter for essentially the same reasons raised with respect to the original claims. Opp. 1–10. We agree and determine that Patent Owner has not satisfied its burden of demonstrating that the proposed substitute claims are patentable under § 101.

As explained above, the addition of a limitation regarding generic computer devices does not limit the claims sufficiently or add concrete ties to make the claims less abstract. *See Alice*, 134 S.Ct. at 2358–59; *Accenture Global Servs.*, 728 F.3d at 1344–45. The limitations requiring that the method is "computer implemented," has "at least one server," and receives "from one or more client servers" "over a communication network" are

[3] We note that proposed claim 30 does not recite a communication network.

generic and conventional for the same reasons discussed above with respect to the original claims. In sum, Patent Owner's proposed amendments are not specific and do not tie the claims to a concrete apparatus or method; rather, the added limitations are generic and insufficient to confer patent eligibility, similar to the claims at issue in *Alice* (which recited a "data storage unit" and "computer," for example), *CLS Bank Int'l v. Alice Corp. Pty. Ltd.*, 717 F.3d 1269, 1289 (Fed. Cir. 2013), and those at issue in *Accenture Global Servs.* (which recited a "database," "client component," "server component," and "automated method," for example), 728 F.3d at 1344–45. Thus, Patent Owner has not shown patentability under 35 U.S.C. § 101. Given that Patent Owner has not established patent eligibility of the claimed subject matter, we do not address whether the proposed substitute claims are patentable over the prior art. *See* Mot. 8–14.

For the foregoing reasons, Patent Owner has not met its burden of showing the patent eligibility of proposed substitute claims 29 and 30.

Accordingly, the contingent Motion to Amend is *denied*.

III. CONCLUSION

This is a Final Written Decision of the Board under 35 U.S.C. § 328(a).

We hold Patent Owner's claims 1–28 of the '498 patent to be unpatentable under 35 U.S.C. § 101. Specifically, the claims recite unpatentable abstract ideas, and the claims do not provide sufficient meaningful limitations to transform these abstract ideas into patent-eligible applications of these abstractions.

ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–28 of the '498 patent are cancelled;

FURTHER ORDERED that Patent Owner's contingent Motion to Amend is *denied*; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

CBM2013-00049
Patent 7,356,498 B2

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ADDENDUM 2

Final Written Decision - 35 U.S.C. § 328(a) and 37 C.F.R. § 42.73, Case CBM2013-00050 (PTAB March 2, 2015) (Paper 51)

A30 – A57

2015-1728, -1729 & -1730

Chicago Board Options Exchange, Incorporated
v.
International Securities Exchange, LLC

Trials@uspto.gov
571.272.7822

Paper No. 51
Filed: March 2, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTERNATIONAL SECURITIES EXCHANGE, LLC,
Petitioner,

v.

CHICAGO BOARD OPTIONS EXCHANGE, INC.,
Patent Owner.

Case CBM2013-00050
Patent 7,980,457 B2

Before JUSTIN T. ARBES, RAMA G. ELLURU, and JAMES B. ARPIN, *Administrative Patent Judges.*

ELLURU, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 328(a) and 37 C.F.R. § 42.73

I. BACKGROUND

Petitioner, International Securities Exchange, LLC, filed a second corrected Petition (Paper 8, "Pet.") requesting review under the transitional program for covered business method patents of claims 1–7 of U.S. Patent No. 7,980,457 B2 (Ex. 1001, "the '457 patent"). Patent Owner, Chicago Board Options Exchange, Inc., filed a Preliminary Response (Paper 15, "Prelim. Resp."). On March 4, 2014, pursuant to 35 U.S.C. § 324, we instituted this trial as to claims 1–7 on one ground of unpatentability, 35 U.S.C. § 101 (Paper 16, "Dec. to Inst.").

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 25, "PO Resp."), a First Supplemental Response (Paper 37, "PO First Supp. Resp."), a Second Supplemental Response (Paper 49, "PO Second Supp. Resp."), a Motion to Amend (Paper 24, "Mot."), and a Reply in support of its Motion (Paper 40, "PO Reply"). Petitioner filed a Reply (Paper 34, "Pet. Reply") to Patent Owner's Response, a First Supplemental Reply (Paper 39, "Pet. First Supp. Reply"), a Second Supplemental Reply (Paper 50, "Pet. Second Supp. Reply"), and an Opposition to Patent Owner's Motion to Amend (Paper 35, "Opp.").

An oral hearing was held on August 22, 2014, and a transcript of the hearing is included in the record (Paper 47, "Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 328(a) and 37 C.F.R. § 42.73.

For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–7 of the '457 patent are unpatentable.

A. The '457 Patent

The '457 patent, titled "Automated Trading Exchange System Having Integrated Quote Risk Monitoring and Integrated Quote Modification Services," issued on July 19, 2011, based on U.S. Patent Application 12/035,996 ("the '966 application"), filed February 22, 2008.[1]

The '457 patent relates to automated trading systems for option contracts ("options"). Ex. 1001, 1:15–19, Abstract. Specifically, the claimed invention is directed to systems for managing the risk of a maker of an options market in an automated trading system. *Id.* at 1:15–19.

Options are traded publicly on exchanges. *Id.* at 1:24. Each option covers certain rights to buy or sell an underlying security at a fixed price for a specified period of time. *Id.* at 1:25–28. The potential loss to the buyer of an option is no greater than the initial premium paid for the option, regardless of the performance of the underlying security. *Id.* at 1:34–36. On the contrary, in exchange for the premium, the seller of the option ("the market-maker") assumes the risk of being assigned the obligation to buy or sell the underlying security, according to the option terms, if the contract is exercised. *Id.* at 1:37–41. Thus, writing options may entail large risks to the market-maker. *Id.* at 1:41–42.

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[1] The '996 application is a continuation of U.S. Patent Application No. 09/475,534 ("the '534 application), which issued as U.S. Patent No. 7,356,498 B2 ("the '498 patent"). U.S. Patent Application No. 13/178,289 B2 is a continuation of the '996 application and issued as U.S. Patent No. 8,266,044 B2 ("the '044 patent"). The '457 patent is also the subject of IPR2014-00098. The '498 patent is the subject of CBM2013-00049 and IPR2014-00097. The '044 patent is the subject of CBM2013-00051. Final Written Decisions are entered in these cases concurrently with this Decision.

Many option trading systems utilize an "open outcry" method. *Id.* at 1:50–51. In such systems, market-makers are required to make a two-sided market by providing an order and offer quote. *Id.* at 1:51–53. In a non-automated open outcry system, a market-maker communicates verbally with traders indicating their willingness to buy and sell various quantities of securities. *Id.* at 1:53–56. Because a market-maker in such systems has personal control over the types and number of options traded, the market-maker can manage risk associated with his or her options portfolio. *Id.* at 1:56–58. A market-maker manages risk by modifying quotes for options to favor trades that tend to hedge against unwanted risk. *Id.* at 1:58–62.

The '457 patent Specification states that an automated trading environment already was known in the art. *Id.* at 1:63–65, 2:1–2. An automated computer-based trading system typically records quotes and automatically matches them with orders that enter the system. *Id.* at 1:65–2:1. One disadvantage of known automated trading systems is that the systems execute trades so rapidly that a market-maker may be unable to withdraw or modify his quotes in a timely manner. *Id.* at 2:7–12. Software tools that assess trading option portfolio risk and recommend quote modifications also were known. *Id.* at 2:13–18. An automated trading system, however, processes transactions in the order received. *Id.* at 2:23–25. Thus, even if a market-maker uses such software tools to modify quotes, those tools may be unable to act in time, given the speed at which the automated trading exchange system executes orders. *Id.* at 2:18–23. For example, an automated trading exchange may have a message queue containing additional orders that must be processed before the automated exchange receives and processes the market-maker's quote modification

request. *Id.* at 2:25–30. These known automated trading exchange systems, therefore, limit a market-maker's ability to manage risk. *Id.* at 2:31–39. The '457 patent Specification recognizes the need for a method that automatically modifies quotes under certain trading conditions in an automated trading exchange system. *Id.* at 2:40–42.

The invention of the '457 patent is directed to systems for an automated trading exchange that modify quotes, where the system provides integrated quote risk monitoring and quote modification services. *Id.* at 2:46–48. Thus, one aspect of the invention is an apparatus that implements the method using a computer, having memory, a processor, and a communication port. *Id.* at 2:48–51.

The computer receives orders and quotes, wherein a quote has associated trading parameters, such as a risk threshold. *Id.* at 2:51–54. The computer then may generate a trade by matching the received orders and quotes to previously received orders and quotes. *Id.* at 2:61–63. If a trade is not generated, the computer stores each of the received orders and quotes. *Id.* at 2:63–64. The computer determines whether a market-maker's quote has been filled as a result of the generated trade, and, if so, determines a risk level and aggregate risk level associated with the trade. *Id.* at 2:64–3:1. The computer then compares the aggregate risk level with the market-maker's risk threshold for a quote; if the threshold is exceeded, the computer automatically modifies at least one of the market-maker's remaining quotes. *Id.* at 3:1–4.

B. Illustrative Claim

Of the challenged claims, only claim 1 is an independent claim. Claim 1 of the '457 patent, reproduced below, is illustrative of the challenged claims:

> 1. A system for processing trades of securitized instruments based on security orders and quotes received from client computers, comprising:
>
> at least one server computer comprising a memory, and a processor, said server computer configured to perform the steps of:
>
> receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;
>
> generating a trade by matching said received orders and quotes to previously received orders and quotes;
>
> storing each of said orders and quotes when a trade is not generated;
>
> determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
>
> comparing said aggregate risk level with said risk threshold; and,
>
> automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said threshold is exceeded.

II. ANALYSIS

A. Claim Construction

Consistent with the statute and the legislative history of the AIA,[2] the Patent Trial and Appeal Board ("Board") interprets claims of an unexpired patent using the broadest reasonable construction in light of the specification of the challenged patent. *See Office Patent Trial Practice Guide*, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012); 37 C.F.R. § 42.300(b); *In re Cuozzo Speed Techs., LLC*, No. 2014-1301, 2015 WL 448667, at *5–8 (Fed. Cir. Feb. 4, 2015). There is a "'heavy presumption' that a claim term carries its ordinary and customary meaning." *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (internal citation omitted). In our Decision to Institute, we determined that our analysis did not require an express interpretation of any term. Dec. to Inst. 8. The parties do not contest that determination. *See, e.g.*, Tr. 61:6–17, 102:12–103:18. We likewise determine that, for purposes of this Final Written Decision, our analysis does not require us to provide an express interpretation for any claim term. Nevertheless, to the extent any claim construction is applicable, that construction is consistent with the constructions presented in the contemporaneously issued Decisions in related *inter partes* reviews IPR2014-00097 and IPR2014-00098. Those constructions are as follows.

Claim Term	Construction
"risk level . . . associated with said trade"	"a calculated, measured, or otherwise obtained value of exposure to the possibility of loss related to said trade"

[2] Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) ("AIA").

"aggregate risk level associated with said trade"	"a calculated, measured, or otherwise obtained aggregate value (e.g., combination, sum, weighed sum, difference) of exposure to the possibility of loss related to such trade"
"automatically modifying at least one of the remaining [] specified ones of said quotes in the quote group if said threshold is exceeded"	"automatically cancelling or revising a price or quantity of at least one of the received specified quotes still available for execution"

B. Claims 1–7 of the '457 Patent are Unpatentable as Directed to Non-Statutory Subject Matter

Petitioner challenges claims 1–7 of the '457 patent under 35 U.S.C. § 101, as directed to patent-ineligible subject matter. Pet. 25–33. Patent Owner maintains that its claims are directed to patent-eligible processes because, for example, the claims include specific meaningful limitations that must be performed on programmed computers, electronic exchanges that incorporate the claimed features were an improvement over systems without them, the claimed steps cannot be performed manually, the claims are not directed to similar or substantially similar methods of managing risk market-makers previously used, and the claims do not preempt hedging risk management techniques. PO Resp. 39–75.

1. 35 U.S.C. § 101 Patentability Analysis

Under 35 U.S.C. § 101, we must first identify whether an invention fits within one of the four statutorily provided categories of patent-eligibility: "processes, machines, manufactures, and compositions of matter." *Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 713–714 (Fed. Cir.

2014). Here, each of the challenged claims recites a "machine," e.g., a system, under § 101.

Section 101 of the Patent Act defines subject matter eligibility, and the Supreme Court has "long held that this provision contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable." *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S.Ct. 2347, 2354 (2014) (citing *Assoc. for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S.Ct. 2107, 2116 (2013) (internal quotation marks and brackets omitted)). "The 'abstract ideas' category embodies the longstanding rule that '[a]n idea of itself is not patentable.'" *Alice Corp.*, 134 S.Ct. at 2355 (citing *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972) (quotations omitted)).

In *Alice Corp.*, the Supreme Court emphasized the "*Mayo* framework," which provides "a framework for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts." *Id.* (citing *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S.Ct. 1289, 1298 (2012)). Under the *Mayo* framework, "[w]e must first determine whether the claims at issue are directed to a patent-ineligible concept." *Id.* Next, "we consider the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Id.* (citing *Mayo*, 132 S.Ct. at 1297–98). To be patentable, a claim must do more than simply state the law of nature or abstract idea and add the words "apply it." *Mayo*, 132 S.Ct. at 1294; *see Benson*, 409 U.S. at 67. Furthermore, "the mere recitation of a generic computer cannot transform a patent-ineligible abstract idea into a patent-eligible invention." *Alice Corp.*,

134 S.Ct. at 2358; *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1256 (Fed. Cir. 2014) ("And after *Alice*, there can remain no doubt: recitation of generic computer limitations does not make an otherwise ineligible claim patent-eligible.") (citation omitted). "Thus, if a patent's recitation of a computer amounts to a mere instruction to 'implemen[t]' an abstract idea 'on . . . a computer,' that addition cannot impart patent eligibility." *Alice Corp.*, 134 S.Ct. at 2358 (internal citation omitted).

A challenged claim must incorporate sufficient meaningful limitations to ensure that it claims more than just an abstract idea and is not merely a "'drafting effort designed to monopolize the [abstract idea].'" *Id.* at 2357 (quoting *Mayo*, 132 S.Ct. at 1297). "Simply appending conventional steps, specified at a high level of generality," is not "*enough*" for patent eligibility. *Id.* (quoting *Mayo*, 132 S.Ct. at 1292). Further, the "prohibition against patenting abstract ideas 'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment' or adding 'insignificant postsolution activity.'" *Bilski v. Kappos*, 561 U.S. 593, 610–11 (2010) (quoting *Diamond v. Diehr*, 450 U.S. 175, 191–92 (1981)).

Thus, we analyze the claims to determine whether the claims embody a patent-eligible application of an abstract idea or are directed merely to nothing more than the abstract idea itself.

2. Claims 1–7 of the '457 Patent Are Unpatentably Abstract

In accordance with the Supreme Court's framework, we must first "determine whether the claims at issue are directed to" an abstract idea. *Alice Corp.*, 134 S.Ct. at 2355. The patents at issue in *Alice* claimed "a method of exchanging financial obligations between two parties using a third-party intermediary to mitigate settlement risk." *Id.* at 2356. Like the

method of hedging risk in *Bilski*, 130 S.Ct. at 3240—which the Court deemed "a method of organizing human activity"—*Alice*'s "concept of intermediated settlement" was held to be "'a fundamental economic practice long prevalent in our system of commerce.'" *Alice Corp.*, 134 S.Ct. at 2356 (citations omitted). With respect to the first step of the "*Mayo* framework," the Supreme Court concluded in *Alice Corp.* that "there is no meaningful distinction between the concept of risk hedging in *Bilski* and the concept of intermediated settlement" in *Alice Corp.* and that "[b]oth are squarely within the realm of 'abstract ideas' as we have used that term." *Id.* at 2357.

Here, Petitioner argues that Patent Owner's claims are directed to the abstract concept of "managing trading risk — expressed in the claims as automatically modifying pending quotes so that market makers do not accumulate unacceptable amounts of risk," similar to the "hedging risk" claims in *Bilski*. Pet. 27; Pet. Reply 1, 3–4. Patent Owner does not dispute that the '457 patent claims are directed to an abstract idea. *See* PO Resp. 45 ("Patent Owner respectfully submits that the claims are not *merely* to an abstract idea, but rather provide a specific application of risk management with many specific, meaningful limitations." (emphasis added)); Ex. 1001, 1:15–19. Similar to the concept of intermediated settlement in *Alice Corp.* and the concept of risk hedging in *Bilski*, we conclude that the concept of managing trading risk ("risk management") is an economic practice long prevalent in our system of commerce and squarely within the realm of abstract ideas. As the '457 patent itself explains, in the prior art "open outcry" exchanges, market-makers adjusted their trading strategies in order to manage their exposure, or risk, associated with their holdings by adjusting their quotes to favor trades that would tend to hedge away unwanted

exposure. Ex. 1001, 1:50–62. Furthermore, the claims recite, for example, a server computer configured to perform the steps of "receiving orders and quotes," "generating a trade," "determining a risk level and an aggregate risk level associated with said trade," "comparing said aggregate risk level" with a risk threshold, and "automatically modifying" one of the remaining quotes if the threshold is exceeded (claim 1). Accordingly, we analyze the '457 patent claims to determine whether they incorporate sufficient meaningful limitations to ensure that the claims are more than just an abstract idea. *Mayo*, 132 S.Ct. at 1297.

3. Claims 1–7 of the '457 Patent Are Not Meaningfully Limited Under 35 U.S.C. § 101

Step two of the Supreme Court's "*Mayo* framework" requires that we consider the elements of the claim and determine whether there is "an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.'" *Alice Corp.*, 134 S.Ct. at 2355 (quoting *Mayo*, 132 S.Ct. at 1294).

The relevant inquiry here is whether "additional substantive limitations . . . narrow, confine, or otherwise tie down the claim so that, in practical terms, it does not cover the full abstract idea itself." *Accenture Global Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1344–45 (Fed. Cir. 2013) (internal quotations and citation omitted). As we noted above, the Supreme Court in *Alice Corp.* cautioned that merely limiting the use of an abstract idea "to a particular technological environment" or implementing the abstract idea on a "wholly generic computer" is not sufficient as an additional feature to provide "practical assurance that the

process is more than a drafting effort designed to monopolize the [abstract idea] itself." *Alice Corp.*, 134 S.Ct. at 2358 (citations omitted).

Patent Owner argues that the challenged independent claims "do not merely incorporate a general purpose computer to perform standard computing functions" (PO Resp. 58–59), but rather require "specific programming in the system computer" (*id.* at 48). Patent Owner contends "the challenged claims include meaningful limitations that narrow the claims to a specific implementation of risk management, executed on a new automated exchange trading system." *Id.* at 49. In support, Patent Owner refers extensively to the Declaration of Dr. Tuomas Sandholm. *See e.g.*, *id.* at 59–60, 62, 64, 66 (citing Ex. 2017). Petitioner disagrees and argues that the claims "do nothing but 'apply' an abstract idea of risk management using generic functions of a generic computer." Pet. Reply 9; *see CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1373 (Fed. Cir. 2011) (Section 101 does not embrace a process defined by using a computer to perform a series of mental steps). We are persuaded by Petitioner's argument.

The challenged claims do not require any specialized hardware. As Petitioner contends, the challenged independent claims recite only common computer elements, e.g., "server computer" comprising a "memory" and "processor," recognized as generic computer technology by the Supreme Court in *Alice Corp.* Pet. Reply 2; *see Alice Corp.*, 134 S. Ct. at 2357; *Ultramercial*, 772 F.3d at 713, 722–23. The '457 patent Specification affirms that the claimed systems can be a general purpose computer with a generic programming and processing environment. For example, the '457 patent Specification states: "In accordance with a first aspect of the

invention, an apparatus is implemented using at least one computer, having memory, a processor, and a communication port." Ex. 1001, 2:48–51. The Specification also makes clear that "[v]arious types of *general purpose* or specialized computer apparatus or computing device may be used with or perform operations in accordance with the teachings described herein." *Id.* at 17:29–31 (emphasis added). The '457 patent Specification likewise explains that "system 100 . . . includes a plurality of computers, which may be *one or more* work-stations, servers, mainframes, or other computer hardware platforms that provides sufficient resources to meet the desired trading volume and desired transaction-processing rate." *Id.* at 3:30–35 (emphasis added). Thus, the Specification indicates that the claimed systems for processing trades of securitized instruments can be built using a general purpose computer and that the complexity of the system depends only on the volume and rate of trading desired.

Furthermore, the Specification explains that the claimed systems can be implemented using known off-the-shelf computer hardware. For example, the Specification states that preferable servers are off-the-shelf "SUN Enterprise™" or "Starfire™" servers. *Id.* at 3:41–45; Tr. 37:15–17. Our review of the patent does not indicate that specialized computer hardware is necessary to implement the claimed systems, similar to the claims at issue in *Alice Corp.* *See Alice Corp.*, 134 S.Ct. at 2360 (determining that the hardware recited in the claims was "purely functional and generic," and did not "offer[] a meaningful limitation beyond generally linking the use of the [method] to a particular technological environment, that is, implementation via computers") (citations and internal quotation marks omitted).

Patent Owner refers extensively to the declaration of its witness, Dr. Sandholm, in support of its position that the claimed systems require specialized and customized hardware and software. PO Resp. 58–63 (citing Ex. 2017 ¶¶ 25–28, 34, 38–39, 41). We do not find Dr. Sandholm's testimony persuasive, however, because it generally relates to commercial embodiments and is not supported by the '457 patent Specification. *See*, *e.g.*, Ex. 2017 ¶ 26. For example, Dr. Sandholm states that systems for processing trades of securitized instruments "include extremely large server networks with extensive processing capabilities" (Ex. 2017 ¶ 25), but the claims do not require any particular network size or extent of processing capability. Further, the '457 patent Specification explains otherwise. According to the Specification, the preferred embodiment of the invention "includes a plurality of computers, which may be *one or more* work-stations, servers, mainframes, or other computer hardware platforms that provide sufficient resources to meet the desired trading volume and desired transaction-processing rate." Ex. 1001, 3:28–35 (emphasis added), 3:35–45.

Patent Owner also argues that, although the '457 patent Specification recognizes that generic hardware can provide the starting materials needed to implement the claimed systems, the hardware must be programmed specifically to implement the patent, "such that [the systems] can perform the operations defined by the claims of the '457 patent." PO Resp. 77; PO First Supp. Resp. 3–4. The Supreme Court, however, has stated expressly that simply executing an abstract concept on a computer does not render a computer "specialized," nor does it automatically transform a patent-ineligible claim into a patent-eligible one. *See Alice Corp.*, 134 S.Ct. at 2358 ("[T]he mere recitation of a generic computer cannot transform a

patent-ineligible abstract idea into a patent-eligible invention. . . . Given the ubiquity of computers, wholly generic computer implementation is not generally the sort of additional featur[e] that provides any practical assurance that the process is more than a drafting effort designed to monopolize the [abstract idea] itself.") (citations and quotation marks omitted); *Bancorp Servs., L.L.C. v. Sun Life Assurance Co.,* 687 F.3d 1266, 1280 (Fed. Cir. 2012). Consequently, we determine that the challenged claims' purported use of a generic computer, configured to perform the steps recited in the claims, does not confer patent eligibility, similar to the claims at issue in *Alice Corp. See Dealertrack, Inc. v. Huber*, 674 F.3d 1315, 1334 (Fed. Cir. 2012) ("In considering patent eligibility under § 101, one must focus on the claims.").

Patent Owner further argues that the challenged claims include many steps that define the relationship of the various limitations and how the claimed functions are accomplished within the exchange trading system, demonstrating that those claims are directed to an application of an abstract idea. PO Resp. 46–48. Patent Owner emphasizes that the claims require the server computer to be configured to perform at least 15 specific steps and sub-steps. *Id.* at 48. Patent Owner notes, for example, that "claim 1 requires that the 'quotes have associated trading parameters comprising a risk threshold.'" *Id.* at 49. Patent Owner contends that "[t]he addition of this new trading parameter, a risk threshold, which is associated with a market maker's quotes, was in no way routine or conventional." *Id.* We are not persuaded by Patent Owner's argument.

The claims contemplate using a generic computer to perform "'well-understood, routine, conventional activit[ies]' previously known to the

industry." *Alice Corp.*, 134 S.Ct. at 2359 (quoting *Mayo*, 132 S.Ct. at 1294); *see Mayo*, 132 S.Ct. at 1300 ("simply appending conventional steps, specified at a high level of generality, to laws of nature, natural phenomena, and abstract ideas cannot make those laws, phenomena, and ideas patentable"). The '457 patent explains that, in the known open outcry method of trading, market-makers had personal control over the types and number of contracts traded, and could "adjust their trading strategies" as their positions changed. Ex. 1001, 1:50–58. Thus, they managed their exposure, or risk, associated with their holdings by "adjusting their quotes" to favor trades that would tend to hedge away unwanted exposure. *Id.* at 1:58–62. The '457 patent Specification also recognizes that software analysis tools were available in the prior art to evaluate the "risk associated with stock and option portfolios." *Id.* at 2:13–18. That it was well known to manage trading risk is supported by the testimony of Dr. Maureen O'Hara, Petitioner's witness. Ex. 1004 ¶ 44 (stating that the steps which the server computer in claim 1 is configured to perform amount to "exactly the same method of managing risk that market makers have been performing manually for years prior to the December 1999 filing date of the '457 patent . . . selectively accounting for past trades and current holdings and/or evaluating greek values"). Also, the claimed "risk threshold" of claim 1 is recited at a high level of generality, and as Petitioner argues, emulates the personal tolerance level of a market-maker with respect to a type of risk. Pet. Reply 5, 7. Lastly, there is no dispute that the prior art included "automated and computer-based trading system[s]." Ex. 1001, 1:66–67. The claimed systems integrate an automated exchange trading system, already known in the art, with methods that mitigate the risks of a market-

maker, also already known in the art. *See id.* at 2:46–48. In sum, the claims amount to nothing more than instructions to apply previously known methods of electronic trading and trade risk management using a generic computer to perform generic computer functions—calculating a risk and determining if that risk exceeds a threshold, and, if so, automatically modifying a quote. *See Alice Corp.*, 134 S.Ct. at 2359.

Moreover, we agree with Petitioner that the challenged claims are patent ineligible because the claims "do nothing more than automate an abstract and mental risk management technique used by market makers in open outcry exchanges for decades." Pet. Reply 4–5 (citing *Bancorp*, 687 F.3d at 1279 ("[u]sing a computer to accelerate an ineligible mental process does not make that process patent-eligible")). As discussed above, in the prior art outcry options trading systems, market-makers determined and hedged their risks mentally. Ex. 1001, 1:50–62; Ex. 1004 ¶ 44; Ex. 1006, 244:24–245:20. We do not find persuasive Patent Owner's arguments that the claimed systems are limited to steps performed by the exchange trading system and cannot be performed manually because a human "cannot perform the functions of an exchange trading system." PO Resp. 71–72. Patent Owner's argument that a human cannot handle millions, or hundreds of millions, of orders and quotes each day misses the point. *See* Tr. 69:22–73:13. The claims are not limited to a certain quantity of trading, and the claimed invention's ability to handle a large amount of orders and quotes is the function of a generic computer. Also, reciting that the claimed steps be performed by the exchange trading system, a system that was indisputably known in the art, and which the patent makes clear can be a generic computer system, does not confer patent eligibility. *See Mayo*, 132 S.Ct. at

1300 (simply appending conventional steps, specified at a high level of generality, to abstract ideas cannot make those ideas patent eligible); Tr. 59:8–61:7 (Patent Owner arguing that we need not define the claim term "automated exchange trading system" precisely).

Relying on the Supreme Court's decision in *Alice Corp.*, Patent Owner argues that the claimed invention is patent eligible because it effects an improvement in the technological area of automated exchange trading systems. *See*, *e.g.*, PO Resp. 50–51, *id.* at 74–75 (arguing that challenged claims satisfy the "machine-or-transformation" test because the claims are directed to an improved trading system with risk management functionality); PO Second Supp. Resp. 1–2; Tr. 44:16–46:12, 47:20–23, 48:22–50:6, 55:13–56:2, 60:25–61:2; *see Alice Corp.*, 134 S.Ct. at 2359 (distinguishing patent ineligible method claims at issue from claims that "effect an improvement in any other technology or technical field"). Patent Owner contends that the claimed invention solves a new risk posed by electronic trading systems that was not present in prior art open outcry trading systems. *See* Tr. 105:15–16 (Petitioner agreeing that automated exchanges are a technical field). Patent Owner refers to the patent to explain the new risk posed by automated trading systems. PO Resp. 70–71.

The '457 patent Specification explains that with computerized trading systems and increased communication speeds, the speed and rapidity of trades may exceed the market maker's ability to adapt his or her position, resulting in an unacceptable risk being assumed by a market maker. Ex. 1001, 1:63–2:10. "That is, the trades may occur so rapidly that the market-maker is unable to withdraw or modify his quotes in a timely manner." *Id.* at 2:10–12; Tr. 58:23–25 (Patent Owner arguing that "when you say an

automated trading system, it means something that allows for . . . automated, fast, fast trading"); Tr. 72:16–23 (Patent Owner stating that in an automated trading system, quotes can get satisfied "before the market maker even has the opportunity to know that it is going on," so the market-maker "doesn't have the chance to do any calculations"). Patent Owner further explains that, in an electronic exchange, market-makers must be proactive and maintain a large number of outstanding persistent quotes that are stored in the exchange's order book, which can be accessed by brokers for execution, without first communicating with the broker. PO Resp. 19–20 (citing Ex. 2016 ¶ 48). Thus, Patent Owner contends that an automated exchange trading system that incorporates the claimed risk management features is an "improvement over [exchange] trading systems without them." PO Resp. 54. We determine that the invention, even as characterized by Patent Owner, does not fall within the scope of patent eligible subject matter as described by the Supreme Court.

The "new risk" described by Patent Owner is the result of automated trading. *See* Tr. 79:10–12. The claimed invention solves the problem by automating risk management, i.e., "automatically" modifying quotes. *See* PO Resp. 71 (Patent Owner emphasizes that the present invention automatically modifies quotes). Whereas in the open outcry system, the market-maker was aware of each trade and could make a decision about the trade, in the claimed invention, the computer is aware of each trade that takes place and makes the risk calculation based on those trades, automatically modifying quotes to protect the trader against a risk which did not exist in the open outcry system. Tr. 73:4–20; *see* PO Resp. 18–19 ("the role of market makers is now frequently performed by specially

programmed computers that act as market makers"). The function of "automatically" modifying quotes, however, is the result of integrating risk calculation and quote modification into an automated trading exchange system. That integration allows the computer to make quote modifications at a faster pace. In other words, "it is the [automation of the abstract idea of risk management] that is integral to [the] claims at issue, not the computer machinery that may be used to accomplish it." *See Bancorp. Servs.*, 687 F.3d at 1279. As Petitioner argues, "[e]ven if [Patent Owner] came up with a wonderful new risk hedging technique, it is still an abstract concept." Tr. 23:22–24; *see* Pet. First Supp. Reply 4 (the purported innovation of the '457 patent is "to simply provide a software application executable on generic computing technology for automating abstract risk management techniques" (emphasis omitted)).

In further support of its position that the claims lack a meaningful limitation, Petitioner maintains that the claims preempt all practical uses of the abstract idea of the known risk management technique. Pet. Reply 3; *see also* Pet. Second Supp. Reply 1–2 (contending that the recent *Ultramercial* decision makes it clear that Patent Owner's arguments regarding pre-emption "are not a substitute for the proper two-part test under *Alice*"). Patent Owner disagrees, maintaining instead that the challenged claims do not preempt the "entire field" of managing trading risk. PO Resp. 73–74. Specifically, Patent Owner argues that the claims cover only "specific applications of this idea," and do not present the risk of pre-empting the field of managing trading risk. *Id.* We are not persuaded by Patent Owner's argument.

The issue is whether the claims preempt the abstract idea of risk management that is claimed. The abstract idea of the challenged claims is not only risk management in general, but also the specific type of risk management claimed in each claim. Furthermore, limiting an abstract idea to a specific field of use or adding token post-solution activity does not make an abstract idea patentable. *Diehr*, 450 U.S. at 191–92; *Parker v. Flook*, 437 U.S. 584, 590 (1978) ("[t]he notion that post-solution activity, no matter how conventional or obvious in itself, can transform an unpatentable principle into a patentable process exalts form over substance"). Therefore, we determine that the limitations of the challenged claims do not meaningfully limit the claim beyond the claimed abstract idea of risk management, and, in practical terms, preempt the abstract idea of risk management.

With respect to dependent claims 2–7, Petitioner argues that they "recite mere engineering specifics, which are nothing more than matters of mere 'design choice' and, thus, conventional and obvious routine activity that does not make the claims patent eligible." Pet. 32. For example, dependent claim 3 limits claim 1 through the inclusion of a "quote data structure" comprising a "bid quote field" and "offer quote field," claim 4 by including a "group indicator field," and claim 5 by including a "quote modification increment field." Patent Owner does not make separate arguments for the dependent claims. We agree with Petitioner that the dependent claims do not include meaningful limitations that make them patent eligible subject matter under *Alice*.

For the foregoing reasons, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the challenged claims are directed to patent-ineligible subject matter under § 101.

C. 35 U.S.C. § 101 is a Condition of Unpatentability

Lastly, Patent Owner maintains that 35 U.S.C. § 101 is not a proper ground for covered business method patent review. PO Resp. 79. We addressed this issue in our Decision to Institute. Dec. to Inst. 14–16. We adhere to that determination.

The Supreme Court has recognized § 101 as a condition for patentability. *See, e.g.*, *Mayo*, 132 S.Ct. at 1305 (addressing invalidity under § 101 when it was raised as a defense to an infringement claim); *Graham v. John Deere Co*, 383 U.S. 1, 12 (1966) (stating that the 1952 Patent Act "sets out the *conditions of patentability* in three sections" (emphasis added), citing 35 U.S.C. §§ 101, 102, and 103). The Federal Circuit also has recognized that § 101 *is* a condition for patentability that can be raised as an affirmative defense under 35 U.S.C. § 282(b)(2). For example, in *Dealertrack*, the majority rejected the dissent's contention that § 101 is not a "condition for patentability," stating that "the 'defenses provided in the statute,' § 282, include not only the 'conditions of patentability' in §§ 102 and 103, but also those in § 101." 674 F.3d at 1330 n.3 (citing *Aristocrat Techs. Austl. PTY Ltd. v. Int'l Game Tech.*, 543 F.3d 657, 661 (Fed. Cir. 2008) ("It has long been understood that the Patent Act sets out the *conditions for patentability* in three sections: sections 101, 102, and 103.") (emphasis added) (citations omitted))). In addition, the Board's consideration of § 101 challenges in covered business method patent reviews also is consistent with the legislative history of the AIA. *See SAP Am., Inc. v. Versata Dev. Grp., Inc.*,

Case CBM2012-00001, slip op. at 32–35 (PTAB Jan. 9, 2013) (Paper 36) (discussing the legislative history of the AIA as it relates to covered business method patent reviews covering § 101 challenges).

D. Contingent Motion to Amend Independent Claims 1 and 8 is Denied

Because we determine that claims 1–7 are unpatentable, we turn to Patent Owner's contingent request to enter proposed substitute independent claims 8 as a replacement for original independent claim 1. Mot. 1–2. Proposed independent claim 8 is reproduced below with underlining to indicate additions relative to original claims 1:

> 8. A system for processing trades of securitized instruments based on security orders and quotes received from client computers, comprising:
>
> at least one server computer comprising a memory, [[and]] a processor, and executable code maintained on said memory executable by said processor such that said server computer is configured to perform the steps of:
>
> receiving, from one or more client servers over a communication network, orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;
>
> generating a trade by matching said received orders and quotes to previously received orders and quotes;
>
> storing each of said orders and quotes when a trade is not generated;
>
> determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;
>
> comparing said aggregate risk level with said risk threshold; and,

> automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said threshold is exceeded.

Id.

A covered business method patent review is not a patent examination proceeding or a patent reexamination proceeding. A proposed substitute claim, in a motion to amend, is not entered automatically and then examined. If a patent owner's motion to amend is granted, the claim will be added directly to the patent, *without examination*. Therefore, we enter proposed amended claims only upon a showing by the patent owner that the amended claims are patentable. *See Idle Free Sys., Inc. v. Bergstrom, Inc.*, Case IPR2012-00027, slip op. at 33 (PTAB Jan. 7, 2014) (Paper 66); *Volusion, Inc. v. Versata Software, Inc.*, Case CBM2013-00017, slip op. at 2–3 (PTAB Dec. 30, 2013) (Paper 19) (*Idle Free's* guidance relating to IPRs applies to CBMs).

Patent Owner as movant bears the burden to demonstrate patentability and compliance with 37 C.F.R. § 42.221. Patent Owner contends that the proposed substitute claim is supported by the disclosure in the '534 application (Ex. 2023), a parent application of the continuation'996 application that issued as the '457 patent. Mot. 2–6. Patent Owner states that the proposed substitute claims address the sole ground upon which trial was instituted, patent subject matter eligibility under § 101. *Id.* at 7. In support of its argument, Patent Owner essentially makes the same arguments it made with respect to the original claims of the '457 patent. *Id.* at 7–8; PO Reply 1–4. For example, Patent Owner argues that proposed system claim 8 is "directed to a specific computer system instead [of] a general purpose computer" (PO Reply 1), "limited to a specific application of performing

risk management" (*id.* at 3), and "directed to an inventive concept of exchange side risk analysis" (*id.*). Patent Owner characterizes proposed independent claim 8 as reciting "a system for processing trades that includes at least one server computer comprising a memory, a processor, and executable code maintained on the memory." Mot. 7. Thus, Patent Owner maintains that the proposed claim "does not merely use a generic computer to perform or accelerate a mental process." *Id.* at 8. Petitioner opposes the Motion to Amend arguing that the claims do not recite patent eligible subject matter for essentially the same reasons raised with respect to the original claims. Opp. 1–11. We agree and determine that Patent Owner has not satisfied its burden of demonstrating that the proposed substitute claims are patentable under § 101.

As explained above, the addition of a limitation regarding generic computer devices does not limit the claims sufficiently or add concrete ties to make the claims less abstract. *See Alice*, 134 S.Ct. at 2358–59; *Accenture Global Servs.*, 728 F.3d at 1344–45. The limitations requiring "executable code maintained on said memory executable by said processor," so that the server computer is configured to perform the steps of receiving orders and quotes "from one or more client servers over a communication network" are generic and conventional for the same reasons discussed above with respect to the original claims. In sum, Patent Owner's proposed amendments are not specific and do not tie the claim to a concrete apparatus or method; rather, the added limitations are generic and insufficient to confer patent eligibility, similar to the claims at issue in *Alice* (which recited a "data storage unit" and "computer," for example), *CLS Bank Int'l v. Alice Corp. Pty. Ltd.*, 717 F.3d 1269, 1289 (Fed. Cir. 2013), and those at issue in

Accenture Global Servs. (which recited a "database," "client component," "server component," and "automated method," for example), 728 F.3d at 1344–45. Thus, Patent Owner has not shown patentability under 35 U.S.C. § 101. Given that Patent Owner has not established patent eligibility of the claimed subject matter, we do not address whether the proposed substitute claim is patentable over the prior art. *See* Mot. 8–14.

For the foregoing reasons, Patent Owner has not met its burden of showing the patent eligibility of proposed substitute claim 8.

Accordingly, the contingent Motion to Amend is *denied*.

III. CONCLUSION

This is a Final Written Decision of the Board under 35 U.S.C. § 328(a).

We hold Patent Owner's claims 1–7 of the '457 patent to be unpatentable under 35 U.S.C. § 101. Specifically, the claims recite unpatentable abstract ideas, and the claims do not provide sufficient meaningful limitations to transform these abstract ideas into patent-eligible applications of these abstractions.

ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–7 of the '457 patent are cancelled;

FURTHER ORDERED that Patent Owner's contingent Motion to Amend is *denied*; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

CBM2013-00050
Patent 7,980,457 B2

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ADDENDUM 3

Final Written Decision - 35 U.S.C. § 328(a) and 37 C.F.R. § 42.73, Case CBM2013-00051 (PTAB March 2, 2015) (Paper 50)

A58 – A86

2015-1728, -1729 & -1730

Chicago Board Options Exchange, Incorporated
v.
International Securities Exchange, LLC

Trials@uspto.gov
571.272.7822

Paper No. 50
Filed: March 2, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTERNATIONAL SECURITIES EXCHANGE, LLC,
Petitioner,

v.

CHICAGO BOARD OPTIONS EXCHANGE, INC.,
Patent Owner.

Case CBM2013-00051
Patent 8,266,044 B2

Before JUSTIN T. ARBES, RAMA G. ELLURU, and JAMES B. ARPIN, *Administrative Patent Judges.*

ELLURU, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 328(a) and 37 C.F.R. § 42.73

I. BACKGROUND

Petitioner, International Securities Exchange, LLC, filed a second corrected Petition (Paper 7, "Pet.") requesting review under the transitional program for covered business method patents of claims 1–3 of U.S. Patent No. 8,266,044 B2 (Ex. 1001, "the '044 patent"). Patent Owner, Chicago Board Options Exchange, Inc., filed a Preliminary Response (Paper 14, "Prelim. Resp."). On March 4, 2014, pursuant to 35 U.S.C. § 324, we instituted this trial as to claims 1–3 on one ground of unpatentability, 35 U.S.C. § 101 (Paper 15, "Dec. to Inst.").

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 24, "PO Resp."), a First Supplemental Response (Paper 36, "PO First Supp. Resp."), a Second Supplemental Response (Paper 48, "PO Second Supp. Resp."), a Motion to Amend (Paper 23, "Mot."), and a Reply in support of its Motion (Paper 39, "PO Reply"). Petitioner filed a Reply (Paper 33, "Pet. Reply") to Patent Owner's Response, a First Supplemental Reply (Paper 38, "Pet. First Supp. Reply"), a Second Supplemental Reply (Paper 49, "Pet. Second Supp. Reply"), and an Opposition to Patent Owner's Motion to Amend (Paper 35, "Opp.").

An oral hearing was held on August 22, 2014, and a transcript of the hearing is included in the record (Paper 46, "Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 328(a) and 37 C.F.R. § 42.73.

For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–3 of the '044 patent are unpatentable.

A. The '044 Patent

The '044 patent, titled "Automated Trading Exchange System Having Integrated Quote Risk Monitoring and Integrated Quote Modification Services," issued on September 11, 2012, based on U.S. Patent Application No. 13/178,289 ("the '289 application"), filed on July 7, 2011.[1]

The '044 patent relates to automated trading systems for option contracts ("options"). Ex. 1001, 1:18–22, Abstract. Specifically, the claimed invention is directed to systems for managing the risk of a maker of an options market in an automated trading system. *Id.* at 1:18–22.

Options are traded publicly on exchanges. *Id.* at 1:27–28. Each option covers certain rights to buy or sell an underlying security at a fixed price for a specified period of time. *Id.* at 1:28–31. The potential loss to the buyer of an option is no greater than the initial premium paid for the option, regardless of the performance of the underlying security. *Id.* at 1:37–39. On the contrary, in exchange for the premium, the seller of the option ("the market-maker") assumes the risk of being assigned the obligation to buy or sell the underlying security, according to the option terms, if the contract is exercised. *Id.* at 1:40–45. Thus, writing options may entail large risks to the market maker. *Id.* at 1:44–45.

Many option trading systems utilize an "open outcry" method. *Id.* at

[1] The '289 application is a continuation of U.S. Patent Application No. 12/035,996 ("the '996 application"), which issued as U.S. Patent No. 7,980,457 B2 ("the '457 patent"). The '996 application is a continuation of U.S. Patent Application No. 09/475,534, which issued as U.S. Patent No. 7,356,498 B2 ("the '498 patent"). The '457 patent is the subject of CBM2013-00050 and IPR2014-00098. The '498 patent is the subject of CBM2013-00049 and IPR2014-00097. Final Written Decisions also are entered in these cases concurrently with this Decision.

1:53–54. In such systems, market-makers are required to make a two-sided market by providing an order and offer quote. *Id.* at 1:54–56. In a non-automated open outcry system, a market-maker communicates verbally with traders indicating their willingness to buy and sell various quantities of securities. *Id.* at 1:56–59. Because a market-maker in such systems has personal control over the types and number of options traded, the market-maker can manage risk associated with his or her options portfolio. *Id.* at 1:59–61. A market-maker manages risk by modifying quotes for options to favor trades that tend to hedge against unwanted risk. *Id.* at 1:61–65.

The '044 patent Specification states that an automated trading environment already was known in the art. *Id.* at 1:66, 2:1–8. An automated computer-based trading system typically records quotes and automatically matches them with orders that enter the system. *Id.* at 1:66–2:4. One disadvantage of known automated trading systems is that the systems execute trades so rapidly that a market-maker may be unable to withdraw or modify his quotes in a timely manner. *Id.* at 2:4–15.

Software tools that assess trading option portfolio risk and recommend quote modifications also were known. *Id.* at 2:16–21. An automated trading system, however, processes transactions in the order received. *Id.* at 2:26–28. Thus, even if a market-maker uses such software tools to modify quotes, those tools may be unable to act in time, given the speed at which the automated trading exchange system executes orders. *Id.* at 2:21–26. For example, an automated trading exchange may have a message queue containing additional orders that must be processed before the automated exchange receives and processes the market-maker's quote modification request. *Id.* at 2:28–33. These known automated trading

exchange systems, therefore, limit a market-maker's ability to manage risk. *Id.* at 2:34–42. The '044 patent Specification recognizes the need for a method that automatically modifies quotes under certain trading conditions in an automated trading exchange system. *Id.* at 2:43–45.

The invention of the '044 patent is directed to systems for an automated trading exchange that modify quotes, where the system provides integrated quote risk monitoring and quote modification services. *Id.* at 2:49–51. Thus, one aspect of the invention is an apparatus that implements the method using a computer, having memory, a processor, and a communication port. *Id.* at 2:51–54.

The computer receives orders and quotes, wherein a quote has associated trading parameters, such as a risk threshold. *Id.* at 2:54–57. The computer then may generate a trade by matching the received orders and quotes to previously received orders and quotes. *Id.* at 2:64–66. If a trade is not generated, the computer stores each of the received orders and quotes. *Id.* at 2:66–67. The computer determines whether a market-maker's quote has been filled as a result of the generated trade, and, if so, determines a risk level and aggregate risk level associated with the trade. *Id.* at 2:67–3:4. The computer then compares the aggregate risk level with the market-maker's risk threshold for a quote; if the threshold is exceeded, the computer automatically modifies at least one of the market-maker's remaining quotes. *Id.* at 3:4–7.

B. Illustrative Claim

Of the challenged claims, claim 1 is the only independent claim. Claim 1 of the '044 patent, reproduced below, is illustrative of the challenged claims:

1. A system for processing trades of securitized instruments based on security orders and quotes received from client computers, comprising:

at least one server computer comprising a memory, and a processor, said server computer configured to perform the steps of:

receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a predefined number of bought or sold contracts relating to said quote group;

generating a trade by matching said received orders and quotes to previously received orders and quotes;

storing each of said orders and quotes when a trade is not generated;

determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a number of contracts that have been bought or sold within said quote group, including the generated trade;

comparing said number of contracts that have been bought or sold within said quote group with said predefined number of bought or sold contracts relating to said quote group; and,

automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said predefined number of bought or sold contracts is exceeded.

II. ANALYSIS

A. Claim Construction

Consistent with the statute and the legislative history of the AIA,[2] the Patent Trial and Appeal Board ("Board") interprets claims of an unexpired patent using the broadest reasonable construction in light of the specification of the challenged patent. *See Office Patent Trial Practice Guide*, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012); 37 C.F.R. § 42.300(b); *In re Cuozzo Speed Techs., LLC*, No. 2014-1301, 2015 WL 448667, at *5–8 (Fed. Cir. Feb. 4, 2015). There is a "'heavy presumption' that a claim term carries its ordinary and customary meaning." *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (internal citation omitted). In our Decision to Institute, we determined that our analysis did not require an express interpretation of any term. Dec. to Inst. 7–8. The parties do not contest that determination. *See, e.g.*, Tr. 61:6–17, 102:12–103:18. We likewise determine that, for purposes of this Final Written Decision, our analysis does not require us to provide an express interpretation for any claim term.

For purposes of this decision, and based on the record before us, we interpret the following claim language: "automatically modifying at least one of the remaining specified ones of said quotes in the quote group," as set forth in claim 1.

We must determine whether the claim limitation encompasses issuing a "new quote." Petitioner's proposed construction for this claim language does not touch upon the term "remaining." Pet. 13.

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[2] Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) ("AIA").

We are persuaded that the Specification differentiates between *modifying* a "remaining quote" and *issuing* a new quote when trades have occurred against previous quotes. Specifically, the '044 patent Specification states:

> The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically *modifies at least one of the remaining quotes* in the quote group. The computer *may also* automatically *regenerate quotes*, *that is*, automatically *issue new quotes* when trades have occurred against previous quotes.

Ex. 1001, 3:4–9 (emphases added). Thus, based on this record, we are persuaded that the recited "automatically modifying at least one of the remaining specified ones of said quotes in the quote group" means "automatically cancelling or revising a price or quantity of at least one of the received specified quotes still available for execution."

B. Claims 1–3 of the '044 Patent are Unpatentable as Directed to Non-Statutory Subject Matter

Petitioner challenges claims 1–3 of the '044 patent under 35 U.S.C. § 101, as directed to patent-ineligible subject matter. Pet. 21–29. Patent Owner maintains that its claims are directed to patent-eligible processes because, for example, the claims include specific meaningful limitations that must be performed on specific hardware configured to perform numbers steps and sub-steps, electronic exchanges that incorporate the claimed features were an improvement over systems without them, the claimed steps cannot be performed manually, the claims are not directed to similar or substantially similar methods of managing risk market-makers previously

used, and the claims do not preempt hedging risk management techniques. PO Resp. 39–75.

1. 35 U.S.C. § 101 Patentability Analysis

Under 35 U.S.C. § 101, we must first identify whether an invention fits within one of the four statutorily provided categories of patent-eligibility: "processes, machines, manufactures, and compositions of matter." *Ultramercial, Inc. v. Hulu, LLC*, 772 F.3d 709, 713–714 (Fed. Cir. 2014). Here, each of the challenged claims recites a "machine," e.g., a system, under § 101.

Section 101 of the Patent Act defines subject matter eligibility, and the Supreme Court has "long held that this provision contains an important implicit exception: Laws of nature, natural phenomena, and abstract ideas are not patentable." *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S.Ct. 2347, 2354 (2014) (citing *Assoc. for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S.Ct. 2107, 2116 (2013) (internal quotation marks and brackets omitted)). "The 'abstract ideas' category embodies the longstanding rule that '[a]n idea of itself is not patentable.'" *Alice Corp.*, 134 S.Ct. at 2355 (citing *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972) (quotations omitted)).

In *Alice Corp.*, the Supreme Court emphasized the "*Mayo* framework," which provides "a framework for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts." *Id.* (citing *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S.Ct. 1289, 1298 (2012)). Under the *Mayo* framework, "[w]e must first determine whether the claims at issue are directed to a patent-ineligible concept." *Id.* Next, "we consider the elements of each claim both individually and 'as an

ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application." *Id.* (citing *Mayo*, 132 S.Ct. at 1297–98). To be patentable, a claim must do more than simply state the law of nature or abstract idea and add the words "apply it." *Mayo*, 132 S.Ct. at 1294; *see Benson*, 409 U.S. at 67. Furthermore, "the mere recitation of a generic computer cannot transform a patent-ineligible abstract idea into a patent-eligible invention." *Alice Corp.*, 134 S.Ct. at 2358; *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1256 (Fed. Cir. 2014) ("And after *Alice*, there can remain no doubt: recitation of generic computer limitations does not make an otherwise ineligible claim patent-eligible.") (citation omitted). "Thus, if a patent's recitation of a computer amounts to a mere instruction to 'implemen[t]' an abstract idea 'on . . . a computer,' that addition cannot impart patent eligibility." *Alice Corp.*, 134 S.Ct. at 2358 (internal citation omitted).

A challenged claim must incorporate sufficient meaningful limitations to ensure that it claims more than just an abstract idea and is not merely a "'drafting effort designed to monopolize the [abstract idea].'" *Id.* at 2357 (quoting *Mayo*, 132 S.Ct. at 1297). "Simply appending conventional steps, specified at a high level of generality," is not "*enough*" for patent eligibility. *Id.* (quoting *Mayo*, 132 S.Ct. at 1292). Further, the "prohibition against patenting abstract ideas 'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment' or adding 'insignificant postsolution activity.'" *Bilski v. Kappos*, 561 U.S. 593, 610–11 (2010) (quoting *Diamond v. Diehr*, 450 U.S. 175, 191–92 (1981)).

Thus, we analyze the claims to determine whether the claims embody a patent-eligible application of an abstract idea or are directed merely to nothing more than the abstract idea itself.

2. Claims 1–3 of the '044 Patent Are Unpatentably Abstract

In accordance with the Supreme Court's framework, we must first "determine whether the claims at issue are directed to" an abstract idea. *Alice Corp.*, 134 S.Ct. at 2355. The patents at issue in *Alice* claimed "a method of exchanging financial obligations between two parties using a third-party intermediary to mitigate settlement risk." *Id.* at 2356. Like the method of hedging risk in *Bilski*, 130 S.Ct. at 3240—which the Court deemed "a method of organizing human activity"—*Alice*'s "concept of intermediated settlement" was held to be "'a fundamental economic practice long prevalent in our system of commerce.'" *Alice Corp.*, 134 S.Ct. at 2356 (citations omitted). With respect to the first step of the "*Mayo* framework," the Supreme Court concluded in *Alice Corp.* that "there is no meaningful distinction between the concept of risk hedging in *Bilski* and the concept of intermediated settlement" in *Alice Corp.* and that "[b]oth are squarely within the realm of 'abstract ideas' as we have used that term." *Id.* at 2357.

Here, Petitioner argues that Patent Owner's claims are directed to the abstract concept of "managing trading risk — expressed in the claims as automatically modifying pending quotes so that market makers do not accumulate unacceptable amounts of risk," similar to the "hedging risk" claims in *Bilski*. Pet. 24; Pet. Reply 1, 3–4. Patent Owner does not dispute that the '044 patent claims are directed to an abstract idea. *See* PO Resp. 46 ("Patent Owner respectfully submits that the claims are not *merely* to an abstract idea, but rather provide a specific application of risk management

with many specific, meaningful limitations." (emphasis added)); Ex. 1001, 1:18–22. Similar to the concept of intermediated settlement in *Alice Corp.* and the concept of risk hedging in *Bilski*, we conclude that the concept of managing trading risk ("risk management") is an economic practice long prevalent in our system of commerce and squarely within the realm of abstract ideas. As the '044 patent itself explains, in the prior art "open outcry" exchanges, market-makers adjusted their trading strategies in order to manage their exposure, or risk, associated with their holdings by adjusting their quotes to favor trades that would tend to hedge away unwanted exposure. Ex. 1001, 1:53–65. Furthermore, the claims recite, for example, a server computer configured to perform the steps of "receiving orders and quotes," "generating a trade," "determining a number of contracts that have been bought or sold within said quote group, including the generated trade," "comparing said number of contracts that have been bought or sold within said quote group with said predefined number of bought or sold contracts relating to said quote group," and "automatically modifying" one of the remaining quotes if the predefined number of bought or sold contracts is exceeded (claim 1). Accordingly, we analyze the '044 patent claims to determine whether they incorporate sufficient meaningful limitations to ensure that the claims are more than just an abstract idea. *Mayo*, 132 S.Ct. at 1297.

3. Claims 1–3 of the '044 Patent Are Not Meaningfully Limited Under 35 U.S.C. § 101

Step two of the Supreme Court's "*Mayo* framework" requires that we consider the elements of the claim and determine whether there is "an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the

[ineligible concept] itself.'" *Alice Corp.*, 134 S.Ct. at 2355 (quoting *Mayo*, 132 S.Ct. at 1294).

The relevant inquiry here is whether "additional substantive limitations . . . narrow, confine, or otherwise tie down the claim so that, in practical terms, it does not cover the full abstract idea itself." *Accenture Global Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1344–45 (Fed. Cir. 2013) (internal quotations and citation omitted). As we noted above, the Supreme Court in *Alice Corp.* cautioned that merely limiting the use of an abstract idea "to a particular technological environment" or implementing the abstract idea on a "wholly generic computer" is not sufficient as an additional feature to provide "practical assurance that the process is more than a drafting effort designed to monopolize the [abstract idea] itself." *Alice Corp.*, 134 S.Ct. at 2358 (citations omitted).

Patent Owner argues that the challenged independent claims "do not merely incorporate a general purpose computer to perform standard computing functions" (PO Resp. 59), but rather require "specific programming in the system computer" (*id.* at 49). Patent Owner contends "the challenged claims include meaningful limitations that narrow the claims to a specific implementation of risk management, executed on a new automated exchange trading system." *Id.* at 49. In support, Patent Owner refers extensively to the Declaration of Dr. Tuomas Sandholm. *See e.g.*, *id.* at 59–61, 67 (citing Ex. 2017). Petitioner disagrees and argues that the claims "do nothing but 'apply' an abstract idea of risk management using generic functions of a generic computer." Pet. Reply 9; *see CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1373 (Fed. Cir. 2011) (Section 101 does not embrace a process defined by using a computer to

perform a series of mental steps). We are persuaded by Petitioner's argument.

The challenged claims do not require any specialized hardware. As Petitioner contends, the challenged independent claims recite only common computer elements, e.g., "server computer" comprising a "memory" and "processor," recognized as generic computer technology by the Supreme Court in *Alice Corp.* Pet. Reply 2; *see Alice Corp.*, 134 S. Ct. at 2357; *Ultramercial*, 772 F.3d at 713, 722–23. The '044 patent Specification affirms that the claimed systems can be a general purpose computer with a generic programming and processing environment. For example, the '044 patent Specification states: "In accordance with a first aspect of the invention, an apparatus is implemented using at least one computer, having memory, a processor, and a communication port." Ex. 1001, 2:51–54. The Specification also makes clear that "[v]arious types of *general purpose* or specialized computer apparatus or computing device may be used with or perform operations in accordance with the teachings described herein." *Id.* at 17:18–20 (emphasis added). The '044 patent Specification likewise explains that "system 100 . . . includes a plurality of computers, which may be *one or more* work-stations, servers, mainframes, or other computer hardware platforms that provides sufficient resources to meet the desired trading volume and desired transaction-processing rate." *Id.* at 3:31–38 (emphasis added). Thus, the Specification indicates that the claimed systems for processing trades of securitized instruments can be built using a general purpose computer and that the complexity of the system depends only on the volume and rate of trading desired.

Furthermore, the Specification explains that the claimed systems can be implemented using known off-the-shelf computer hardware. For example, the Specification states that preferable servers are off-the-shelf "SUN Enterprise™" or "Starfire™" servers. *Id.* at 3:41–47; Tr. 37:15–17. Our review of the patent does not indicate that specialized computer hardware is necessary to implement the claimed systems, similar to the claims at issue in *Alice Corp*. *See Alice Corp.*, 134 S.Ct. at 2360 (determining that the hardware recited in the claims was "purely functional and generic," and did not "offer[] a meaningful limitation beyond generally linking the use of the [method] to a particular technological environment, that is, implementation via computers") (citations and internal quotation marks omitted).

Patent Owner refers extensively to the declaration of its witness, Dr. Sandholm, in support of its position that the claimed systems require specialized and customized hardware and software. PO Resp. 59–64 (citing Ex. 2017 ¶¶ 25–36, 39). We do not find Dr. Sandholm's testimony persuasive, however, because it generally relates to commercial embodiments and is not supported by the '044 patent Specification. *See*, *e.g.*, Ex. 2017 ¶ 26. For example, Dr. Sandholm states that systems for processing trades of securitized instruments "include extremely large server networks with extensive processing capabilities" (Ex. 2017 ¶ 25), but the claims do not require any particular network size or extent of processing capability. Further, the '044 patent Specification explains otherwise. According to the Specification, the preferred embodiment of the invention "includes a plurality of computers, which may be *one or more* work-stations, servers, mainframes, or other computer hardware platforms that provide

sufficient resources to meet the desired trading volume and desired transaction-processing rate." Ex. 1001, 3:34–38 (emphasis added), 3:38–44.

Patent Owner also argues that, although the '044 patent Specification recognizes that generic hardware can provide the starting materials needed to create an automated exchange trading system, "the hardware is ultimately specifically programmed to implement the modules of the patent, such that they can perform the operations defined by the claims of the '044 patent." PO Resp. 77–78; PO First Supp. Resp. 2–3. The Supreme Court, however, has stated expressly that simply executing an abstract concept on a computer does not render a computer "specialized," nor does it automatically transform a patent-ineligible claim into a patent-eligible one. *See Alice Corp.*, 134 S.Ct. at 2358 ("[T]he mere recitation of a generic computer cannot transform a patent-ineligible abstract idea into a patent-eligible invention. . . . Given the ubiquity of computers, wholly generic computer implementation is not generally the sort of additional featur[e] that provides any practical assurance that the process is more than a drafting effort designed to monopolize the [abstract idea] itself.") (citations and quotation marks omitted); *Bancorp Servs., L.L.C. v. Sun Life Assurance Co.*, 687 F.3d 1266, 1280 (Fed. Cir. 2012). Consequently, we determine that the challenged claims' purported use of a generic computer, configured to perform the steps recited in the claims, does not confer patent eligibility, similar to the claims at issue in *Alice Corp*. *See Dealertrack, Inc. v. Huber*, 674 F.3d 1315, 1334 (Fed. Cir. 2012) ("In considering patent eligibility under § 101, one must focus on the claims.").

Patent Owner further argues that the challenged claims include many steps that define the relationship of the various limitations and how the

claimed functions are accomplished within the exchange trading system, demonstrating that those claims are directed to an application of an abstract idea. PO Resp. 46–48. Patent Owner emphasizes that the claims require the server computer to be configured to perform at least 14 specific steps and sub-steps. *Id.* at 48. Patent Owner notes, for example, that "claim 1 requires that the 'quotes have associated trading parameters comprising a predefined number of bought or sold contracts relating to said quote group.'" *Id.* at 49–50. Patent Owner contends that "[t]he addition of this new trading parameter, a risk threshold, which is associated with a market maker's quotes, was in no way routine or conventional." *Id.* at 50. We are not persuaded by Patent Owner's argument.

The claims contemplate using a generic computer to perform "'well-understood, routine, conventional activit[ies]' previously known to the industry." *Alice Corp.*, 134 S.Ct. at 2359 (quoting *Mayo*, 132 S.Ct. at 1294); *see Mayo*, 132 S.Ct. at 1300 ("simply appending conventional steps, specified at a high level of generality, to laws of nature, natural phenomena, and abstract ideas cannot make those laws, phenomena, and ideas patentable"). The '044 patent explains that, in the known open outcry method of trading, market-makers had personal control over the types and number of contracts traded, and could "adjust their trading strategies" as their positions changed. Ex. 1001, 1:53–61. Thus, they managed their exposure, or risk, associated with their holdings by "adjusting their quotes" to favor trades that would tend to hedge away unwanted exposure. *Id.* at 1:61–65. The '044 patent Specification also recognizes that software analysis tools were available in the prior art to evaluate the "risk associated with stock and option portfolios." *Id.* at 2:16–21. That it was well known to

manage trading risk is supported by the testimony of Dr. Maureen O'Hara, Petitioner's witness. Ex. 1004 ¶ 44 (stating that the steps which the server computer in claim 1 is configured to perform amount to "exactly the same method of managing risk that market makers have been performing manually for years prior to the December 1999 filing date of the '044 patent . . . selectively accounting for past trades (such as the volume of past trades) and current holdings and/or evaluating greek values"). Also, the claimed "predefined number of bought or sold contracts relating to said quote group" of claim 1 is recited at a high level of generality, and as Petitioner argues, emulates the personal tolerance level of a market-maker with respect to a type of risk. Pet. Reply 5, 7. Lastly, there is no dispute that the prior art included "automated and computer-based trading system[s]." Ex. 1001, 2:2–3. The claimed systems integrate an automated exchange trading system, already known in the art, with methods that mitigate the risks of a market-maker, also already known in the art. *See id.* at 2:49–51. In sum, the claims amount to nothing more than instructions to apply previously known methods of electronic trading and trade risk management using a generic computer to perform generic computer functions—calculating a risk and determining if that risk exceeds a threshold, and, if so, automatically modifying a quote. *See Alice Corp.*, 134 S.Ct. at 2359.

Moreover, we agree with Petitioner that the challenged claims are patent ineligible because the claims "do nothing more than automate an abstract and mental risk management technique used by market makers in open outcry exchanges for decades." Pet. Reply 4 (citing *Bancorp*, 687 F.3d at 1279 ("[u]sing a computer to accelerate an ineligible mental process does not make that process patent-eligible")). As discussed above, in the prior art

outcry options trading systems, market-makers determined and hedged their risks mentally. Ex. 1001, 1:52–65; Ex. 1004 ¶ 44; Ex. 1005, 244:24–245:20. We do not find persuasive Patent Owner's arguments that the claimed systems are limited to steps performed by the exchange trading system and cannot be performed manually because a human "cannot perform the functions of an exchange trading system." PO Resp. 73. Patent Owner's argument that a human cannot handle millions, or hundreds of millions, of orders and quotes each day misses the point. *See* Tr. 69:22–73:13. The claims are not limited to a certain quantity of trading, and the claimed invention's ability to handle a large amount of orders and quotes is the function of a generic computer. Also, reciting that the claimed steps be performed by the exchange trading system, a system that was indisputably known in the art and which the patent makes clear can be a generic computer system, does not confer patent eligibility. *See Mayo*, 132 S.Ct. at 1300 (simply appending conventional steps, specified at a high level of generality, to abstract ideas cannot make those ideas patent eligible).

Relying on the Supreme Court's decision in *Alice Corp.*, Patent Owner argues that the claimed invention is patent eligible because it effects an improvement in the technological area of automated exchange trading systems. *See*, *e.g.*, PO Resp. 54–64, 74–75 (arguing that challenged claims satisfy the "machine-or-transformation" test because the claims are directed to an improved trading system with risk management functionality); PO Second Supp. Resp. 1–2; Tr. 44:16–46:12, 47:20–23, 48:22–50:6, 55: 13–56:2, 60:25–61:2; *see Alice Corp.*, 134 S.Ct. at 2359 (distinguishing patent ineligible method claims at issue from claims that "effect an improvement in any other technology or technical field"). Patent Owner

contends that the claimed invention solves a new risk posed by electronic trading systems that was not present in prior art open outcry trading systems. *See* Tr. 105:15–16 (Petitioner agreeing that automated exchanges are a technical field). Patent Owner refers to the patent to explain the new risk posed by automated trading systems. PO Resp. 70–71.

The '044 patent Specification explains that with computerized trading systems and increased communication speeds, the speed and rapidity of trades may exceed the market-maker's ability to adapt his or her position, resulting in an unacceptable risk being assumed by a market-maker. Ex. 1001, 2:4–2:15. "That is, the trades may occur so rapidly that the market-maker is unable to withdraw or modify his quotes in a timely manner." *Id.* at 2:13–15; Tr. 58:23–25 (Patent Owner arguing that "when you say an automated trading system, it means something that allows for . . . automated, fast, fast trading"); Tr. 72:16–23 (Patent Owner stating that in an automated trading system, quotes can get satisfied "before the market maker even has the opportunity to know that it is going on," so the market-maker "doesn't have the chance to do any calculations"). Patent Owner further explains that, in an electronic exchange, market-makers must be proactive and maintain a large number of outstanding persistent quotes that are stored in the exchange's order book, which can be accessed by brokers for execution, without first communicating with the broker. PO Resp. 20 (citing Ex. 2016 ¶ 48). Thus, Patent Owner contends that an automated exchange trading system that incorporates the claimed risk management features is an "improvement over [exchange] trading systems without them." PO Resp. 54. We determine that the invention, even as characterized by Patent

Owner, does not fall within the scope of patent eligible subject matter as described by the Supreme Court.

The "new risk" described by Patent Owner is the result of automated trading. *See* Tr. 79:10–12. The claimed invention solves the problem by automating risk management, i.e., "automatically" modifying quotes. *See* PO Resp. 71–72 (Patent Owner emphasizes that the present invention automatically modifies quotes). Whereas in the open outcry system, the market-maker was aware of each trade and could make a decision about the trade, in the claimed invention, the computer is aware of each trade that takes place and makes the risk calculation based on those trades, automatically modifying quotes to protect the trader against a risk which did not exist in the open outcry system. Tr. 73:4–20; *see* PO Resp. 19 ("the role of market makers is now frequently performed by specially programmed computers that act as market makers"). The function of "automatically" modifying quotes, however, is the result of integrating risk calculation and quote modification into an automated trading exchange system. That integration allows the computer to make quote modifications at a faster pace. In other words, "it is the [automation of the abstract idea of risk management] that is integral to [the] claims at issue, not the computer machinery that may be used to accomplish it." *See Bancorp. Servs.*, 687 F.3d at 1279. As Petitioner argues, "[e]ven if [Patent Owner] came up with a wonderful new risk hedging technique, it is still an abstract concept." Tr. 23:22–24.

In further support of its position that the claims lack a meaningful limitation, Petitioner maintains that the claims preempt all practical uses of the abstract idea of the known risk management technique. Pet. Reply 3,

14–15; *see also* Pet. Second Supp. Reply 1–2 (contending that the recent *Ultramercial* decision makes it clear that Patent Owner's arguments regarding pre-emption "are not a substitute for the proper two-part test under *Alice*"). Patent Owner disagrees, maintaining instead that the challenged claims do not preempt the "entire field" of managing trading risk. PO Resp. 73–74. Specifically, Patent Owner argues that the claims cover only "specific applications of this idea," and do not present the risk of pre-empting the field of managing trading risk. *Id.* at 74. We are not persuaded by Patent Owner's argument.

The issue is whether the claims preempt the abstract idea of risk management that is claimed. The abstract idea of the challenged claims is not only risk management in general, but also the specific type of risk management claimed in each claim. Furthermore, limiting an abstract idea to a specific field of use or adding token post-solution activity does not make an abstract idea patentable. *Diehr*, 450 U.S. at 191–92; *Parker v. Flook*, 437 U.S. 584, 590 (1978) ("[t]he notion that post-solution activity, no matter how conventional or obvious in itself, can transform an unpatentable principle into a patentable process exalts form over substance"). Therefore, we determine that the limitations of the challenged claims do not meaningfully limit the claim beyond the claimed abstract idea of risk management, and, in practical terms, preempt the abstract idea of risk management.

With respect to dependent claims 2 and 3, Petitioner argues that they add nothing of significance to independent claim 1, which defines an abstract idea, and amount to nothing more than conventional and routine activity that does not make the claims patent eligible. Pet. 28. For example,

dependent claim 2 limits claim 1 by specifying that "the number of contracts that have been bought or sold comprises a total number of put contracts bought or sold," and claim 3 limits claim 1 by specifying that "the number of contracts that have been bought or sold comprises a total number of call contracts bought or sold." Patent Owner does not make separate arguments for the dependent claims. We agree with Petitioner that the dependent claims do not include meaningful limitations that make them patent eligible subject matter under *Alice*.

For the foregoing reasons, we conclude that Petitioner has demonstrated by a preponderance of the evidence that the challenged claims are directed to patent-ineligible subject matter under § 101.

C. 35 U.S.C. § 101 is a Condition of Unpatentability

Lastly, Patent Owner maintains that 35 U.S.C. § 101 is not a proper ground for covered business method patent review. PO Resp. 79. We addressed this issue in our Decision to Institute. Dec. to Inst. 14–16. We adhere to that determination.

The Supreme Court has recognized § 101 as a condition for patentability. *See, e.g.*, *Mayo*, 132 S.Ct. at 1305 (addressing invalidity under § 101 when it was raised as a defense to an infringement claim); *Graham v. John Deere Co.*, 383 U.S. 1, 12 (1966) (stating that the 1952 Patent Act "sets out the *conditions of patentability* in three sections" (emphasis added), citing 35 U.S.C. §§ 101, 102, and 103). The Federal Circuit also has recognized that § 101 *is* a condition for patentability that can be raised as an affirmative defense under 35 U.S.C. § 282(b)(2). For example, in *Dealertrack*, the majority rejected the dissent's contention that § 101 is not a "condition for patentability," stating that "the 'defenses provided in the statute,' § 282,

include not only the 'conditions of patentability' in §§ 102 and 103, but also those in § 101." 674 F.3d at 1330 n.3 (citing *Aristocrat Techs. Austl. PTY Ltd. v. Int'l Game Tech.*, 543 F.3d 657, 661 (Fed. Cir. 2008) ("It has long been understood that the Patent Act sets out the *conditions for patentability* in three sections: sections 101, 102, and 103.") (emphasis added) (citations omitted))). In addition, the Board's consideration of § 101 challenges in covered business method patent reviews also is consistent with the legislative history of the AIA. *See SAP Am., Inc. v. Versata Dev. Grp., Inc.*, Case CBM2012-00001, slip op. at 32–35 (PTAB Jan. 9, 2013) (Paper 36) (discussing the legislative history of the AIA as it relates to covered business method patent reviews covering § 101 challenges).

D. Contingent Motion to Amend Independent Claim 1is Denied

Because we determine that claims 1–3 are unpatentable, we turn to Patent Owner's contingent request to enter proposed substitute independent claims 4 as a replacement for original independent claim 1. Mot. 1–2. Proposed independent claim 4 is reproduced below with underlining to indicate additions relative to original claims 1:

> 4. A system for processing trades of securitized instruments based on security orders and quotes received from client computers, comprising:
>
> at least one server computer comprising a memory, [[and]] a processor, and executable code maintained on said memory executable by said processor such that said server computer is configured to perform the steps of:
>
> receiving, from one or more client servers over a communication network, orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a predefined

> number of bought or sold contracts relating to said quote group;
>
> generating a trade by matching said received orders and quotes to previously received orders and quotes;
>
> storing each of said orders and quotes when a trade is not generated;
>
> determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a number of contracts that have been bought or sold within said quote group, including the generated trade;
>
> comparing said number of contracts that have been bought or sold within said quote group with said predefined number of bought or sold contracts relating to said quote group; and,
>
> automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said predefined number of bought or sold contracts is exceeded.

Id.

A covered business method patent review is not a patent examination proceeding or a patent reexamination proceeding. A proposed substitute claim, in a motion to amend, is not entered automatically and then examined. If a patent owner's motion to amend is granted, the claim will be added directly to the patent, *without examination*. Therefore, we enter proposed amended claims only upon a showing by the patent owner that the amended claims are patentable. *See Idle Free Sys., Inc. v. Bergstrom, Inc.*, Case IPR2012-00027, slip op. at 33 (PTAB Jan. 7, 2014) (Paper 66); *Volusion, Inc. v. Versata Software, Inc.*, Case CBM2013-00017, slip op. at 2–3 (PTAB Dec. 30, 2013) (Paper 19) (*Idle Free's* guidance relating to IPRs applies to CBMs).

Patent Owner as movant bears the burden to demonstrate patentability and compliance with 37 C.F.R. § 42.221. Patent Owner contends that the proposed substitute claim is supported by the disclosure in the '534 application (Ex. 2023), a parent application of the '289 application, that issued as the '044 patent. Mot. 2–7. Patent Owner states that the proposed substitute claims address the sole ground upon which trial was instituted, patent subject matter eligibility under § 101. *Id.* In support of its argument, Patent Owner essentially makes the same arguments it made with respect to the original claims of the '044 patent. *Id.* at 7–9; PO Reply 1–4. For example, Patent Owner argues that proposed system claim 4 is "directed to a specific computer system instead [of] a general purpose computer" (PO Reply 1), "limited to a specific application of performing risk management" (*id.* at 3), and "directed to an inventive concept of exchange side risk analysis" (*id.*). Patent Owner characterizes proposed independent claim 4 as reciting "a system for processing trades that includes at least one server computer comprising a memory, a processor, and executable code maintained on the memory." Mot. 8. Thus, Patent Owner maintains that the proposed claim "does not merely use a generic computer to perform or accelerate a mental process." *Id.* at 9. Petitioner opposes the Motion to Amend arguing that the claims do not recite patent eligible subject matter for essentially the same reasons raised with respect to the original claims. Opp. 1–12. We agree and determine that Patent Owner has not satisfied its burden of demonstrating that the proposed substitute claims are patentable under § 101.

As explained above, the addition of a limitation regarding generic computer devices does not limit the claims sufficiently or add concrete ties

to make the claims less abstract. *See Alice*, 134 S.Ct. at 2358–59; *Accenture Global Servs.*, 728 F.3d at 1344–45. The limitations requiring "executable code maintained on said memory executable by said processor," so that the server computer is configured to perform the steps of receiving orders and quotes "from one or more client servers over a communication network" are generic and conventional for the same reasons discussed above with respect to the original claims. In sum, Patent Owner's proposed amendments are not specific and do not tie the claim to a concrete apparatus or method; rather, the added limitations are generic and insufficient to confer patent eligibility, similar to the claims at issue in *Alice* (which recited a "data storage unit" and "computer," for example), *CLS Bank Int'l v. Alice Corp. Pty. Ltd.*, 717 F.3d 1269, 1289 (Fed. Cir. 2013), and those at issue in *Accenture Global Servs.* (which recited a "database," "client component," "server component," and "automated method," for example), 728 F.3d at 1344–45. Thus, Patent Owner has not shown patentability under 35 U.S.C. § 101. Given that Patent Owner has not established patent eligibility of the claimed subject matter, we do not address whether the proposed substitute claim is patentable over the prior art. *See* Mot. 9–15.

For the foregoing reasons, Patent Owner has not met its burden of showing the patent eligibility of proposed substitute claim 4.

Accordingly, the contingent Motion to Amend is *denied*.

III. CONCLUSION

This is a Final Written Decision of the Board under 35 U.S.C. § 328(a). We hold Patent Owner's claims 1–3 of the '044 patent to be unpatentable under 35 U.S.C. § 101. Specifically, the claims recite unpatentable abstract ideas, and the claims do not provide sufficient

meaningful limitations to transform these abstract ideas into patent-eligible applications of these abstractions.

ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–3 of the '044 patent are cancelled;

FURTHER ORDERED that Patent Owner's contingent Motion to Amend is *denied*; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

CBM2013-00051
Patent 8,266,044 B2

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ADDENDUM 4

U.S. Patent No. 7,356,498,
Case CBM2013-00049 (PTAB) (Exhibit 1001)

A87 – A106

2015-1728, -1729 & -1730

Chicago Board Options Exchange, Incorporated
v.
International Securities Exchange, LLC

US007356498B2

(12) **United States Patent**
Kaminsky et al.

(10) **Patent No.: US 7,356,498 B2**
(45) **Date of Patent: Apr. 8, 2008**

(54) **AUTOMATED TRADING EXCHANGE SYSTEM HAVING INTEGRATED QUOTE RISK MONITORING AND INTEGRATED QUOTE MODIFICATION SERVICES**

(75) Inventors: **Ross G. Kaminsky**, Chicago, IL (US); **Richard A. Angell**, Evanston, IL (US); **Gordon D. Evora**, Chicago, IL (US)

(73) Assignee: **Chicago Board Options Exchange, Incorporated**, Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/475,534**

(22) Filed: **Dec. 30, 1999**

(65) **Prior Publication Data**

US 2002/0082967 A1 Jun. 27, 2002

(51) **Int. Cl.**
G06Q 40/00 (2006.01)

(52) **U.S. Cl.** **705/37**; 705/38

(58) **Field of Classification Search** 705/35, 705/37, 38, 39, 42, 44, 40, 41

See application file for complete search history.

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Primary Examiner—Andrew Joseph Rudy
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(57) **ABSTRACT**

An automated trading exchange having integrated quote risk monitoring and quote modification services. An apparatus is implemented using at least one computer, having memory, and a processor. The computer is configured to receive orders and quotes, wherein specified ones of the quotes are contained in a quote group, and have associated trading parameters such as a risk threshold. Not all received quotes are required to have trading parameters as described herein. Preferably, the quote group contains all the quotes, or a subset of quotes, belonging to an individual market-maker for a given class of options contracts, or possibly the quotes of two or more market-makers that have identified themselves as belonging to a group for the purposes of risk monitoring and quote modification. The computer typically generates a trade by matching the received orders and quotes to previously received orders and quotes, and otherwise stores each of the received orders and quotes if a trade is not generated. The computer then determines whether a quote within the quote group has been filled as a result of the generated trade, and if so, determines a risk level and an aggregate risk level associated with said trade. The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically modifies at least one of the remaining quotes in the quote group. The computer may also automatically regenerate quotes that have been filled.

28 Claims, 7 Drawing Sheets

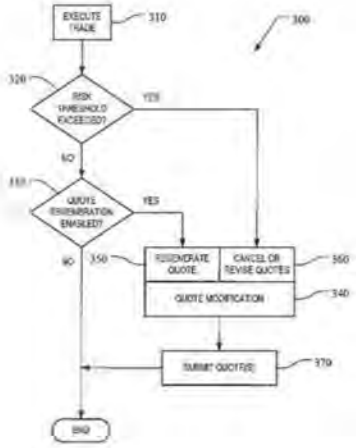

EXHIBIT
ISE 1001

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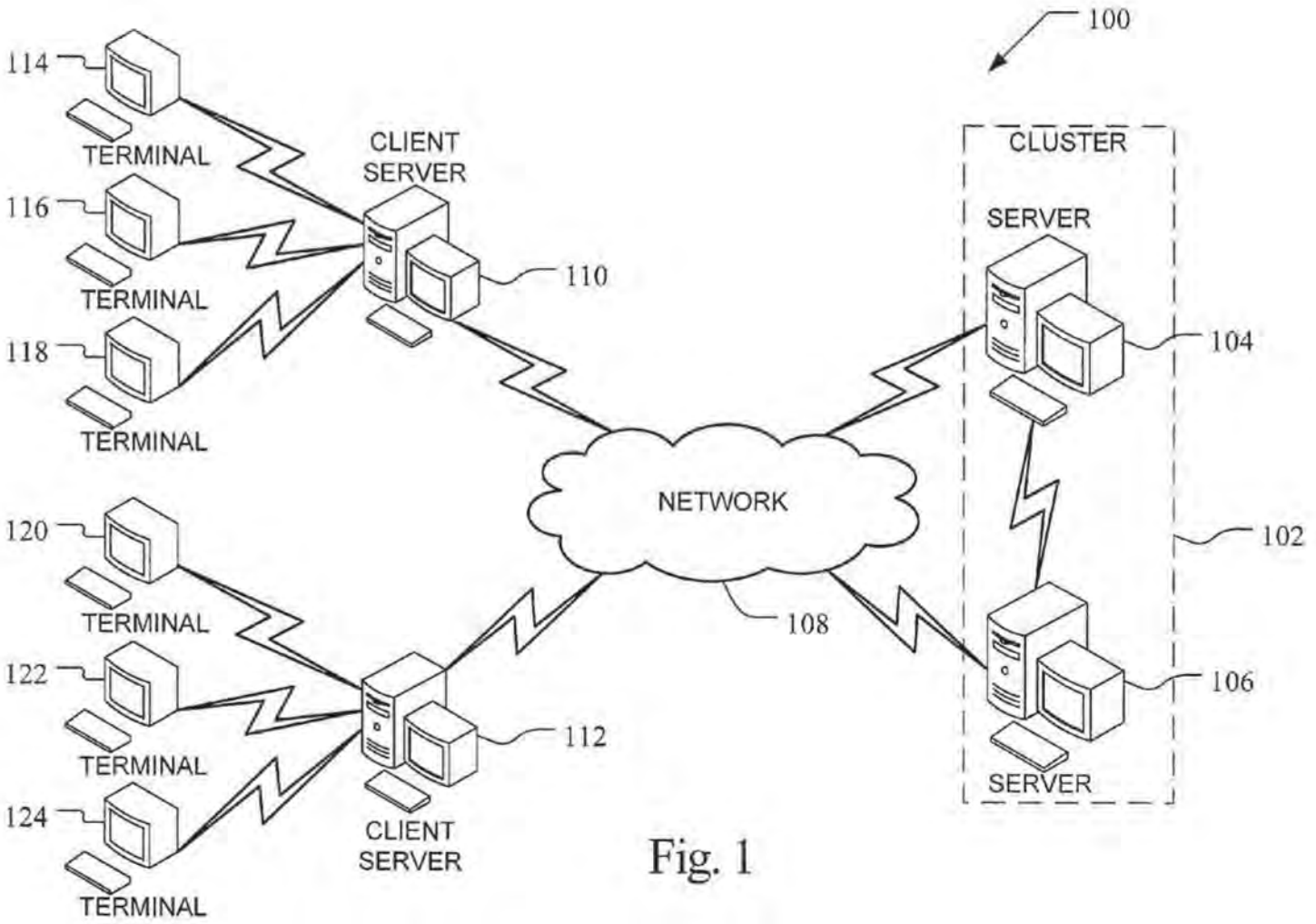
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TERMINAL
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110
NETWORK
108
CLUSTER
SERVER
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102
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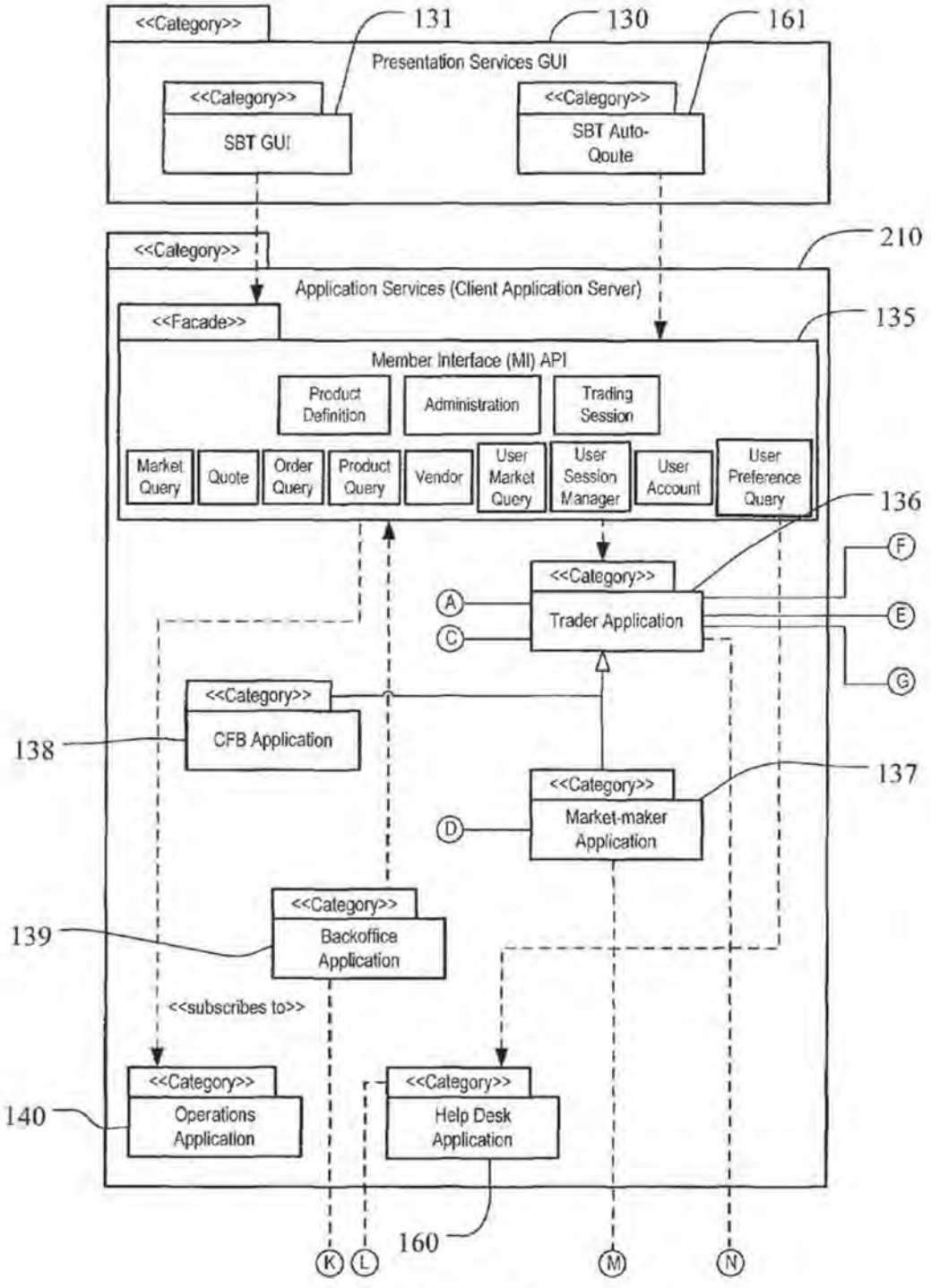
SERVER
120
TERMINAL
122
TERMINAL
124
TERMINAL
112
CLIENT SERVER

Fig. 1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210
Application Services (Client Application Server)
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Member Interface (MI) API
Product Definition
Administration
Trading Session
Market Query
Quote
Order Query
Product Query
Vendor
User Market Query
User Session Manager
User Account
User Preference Query
136
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Trader Application
A
C
F
E
G
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CFB Application
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Market-maker Application
137
D
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Help Desk Application
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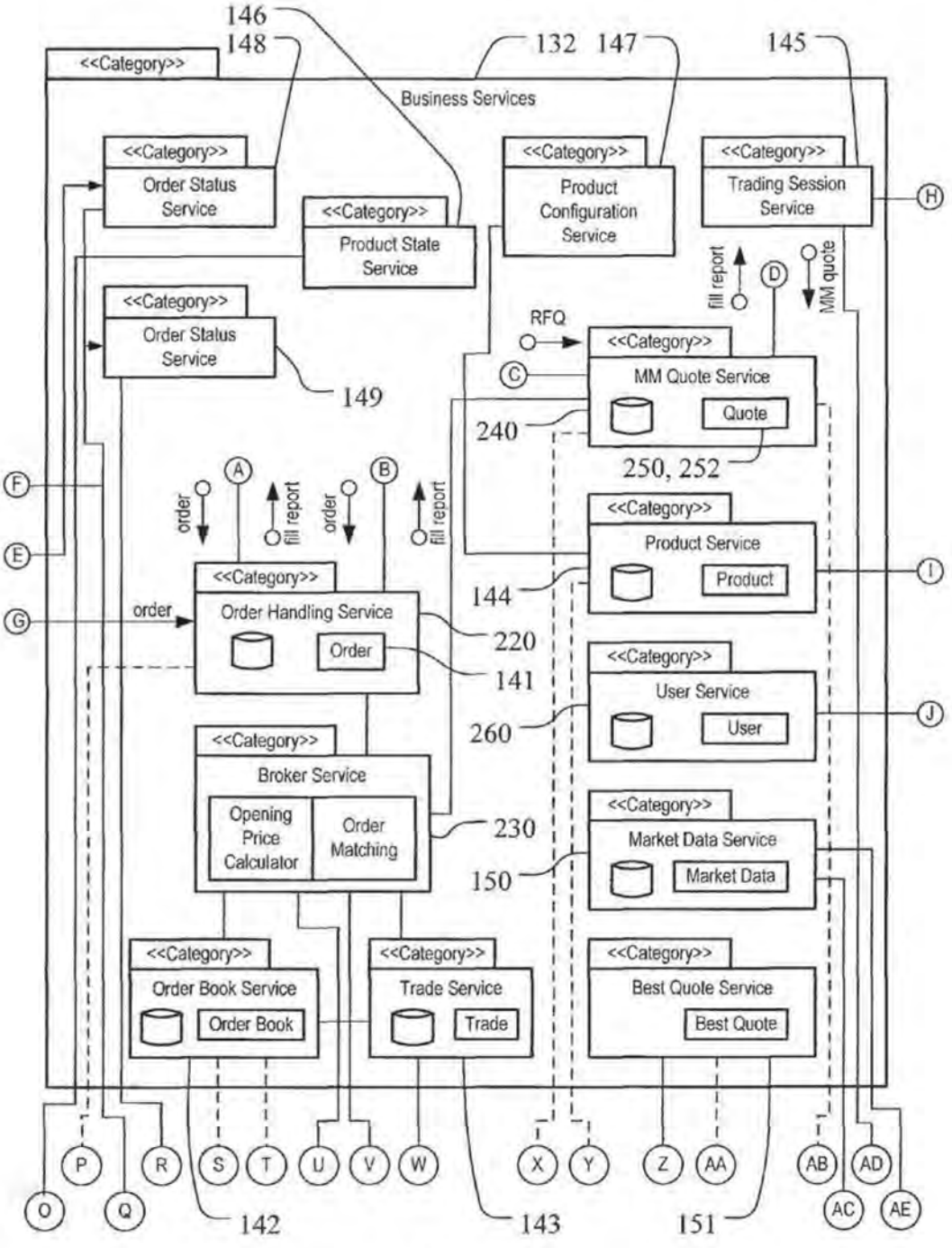
M
N

Fig. 2A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Quote
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F
E
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B
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fill report
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Order
220
141
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User Service
User
J
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Broker Service
Opening Price Calculator
Order Matching
230
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Market Data Service
Market Data
150
<<Category>>
Order Book Service
Order Book
<<Category>>
Trade Service
Trade
<<Category>>
Best Quote Service
Best Quote
O
P
Q
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V
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X
Y
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AA
AB
AC
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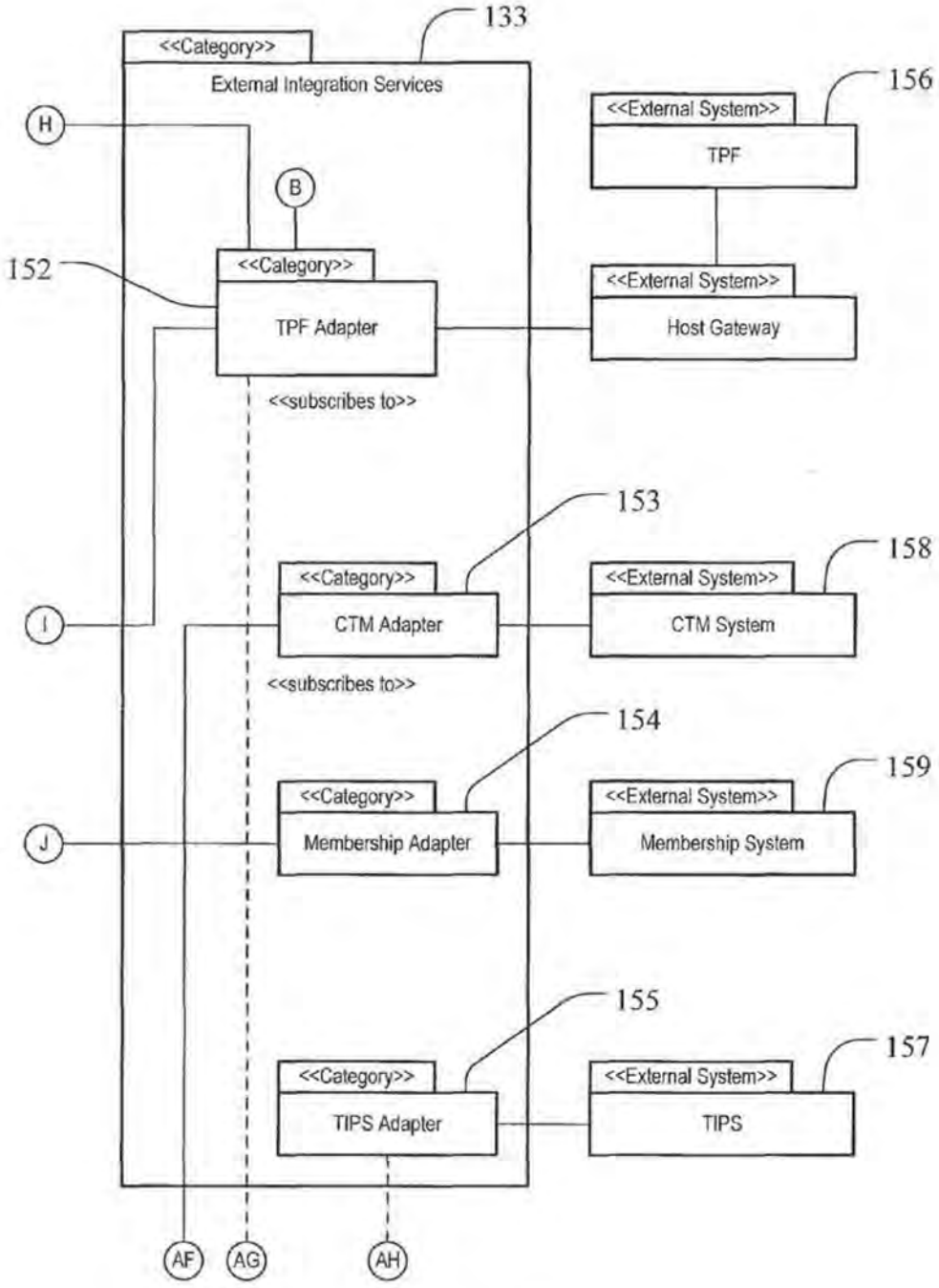
AE
142
143
151

Fig. 2B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Host Gateway
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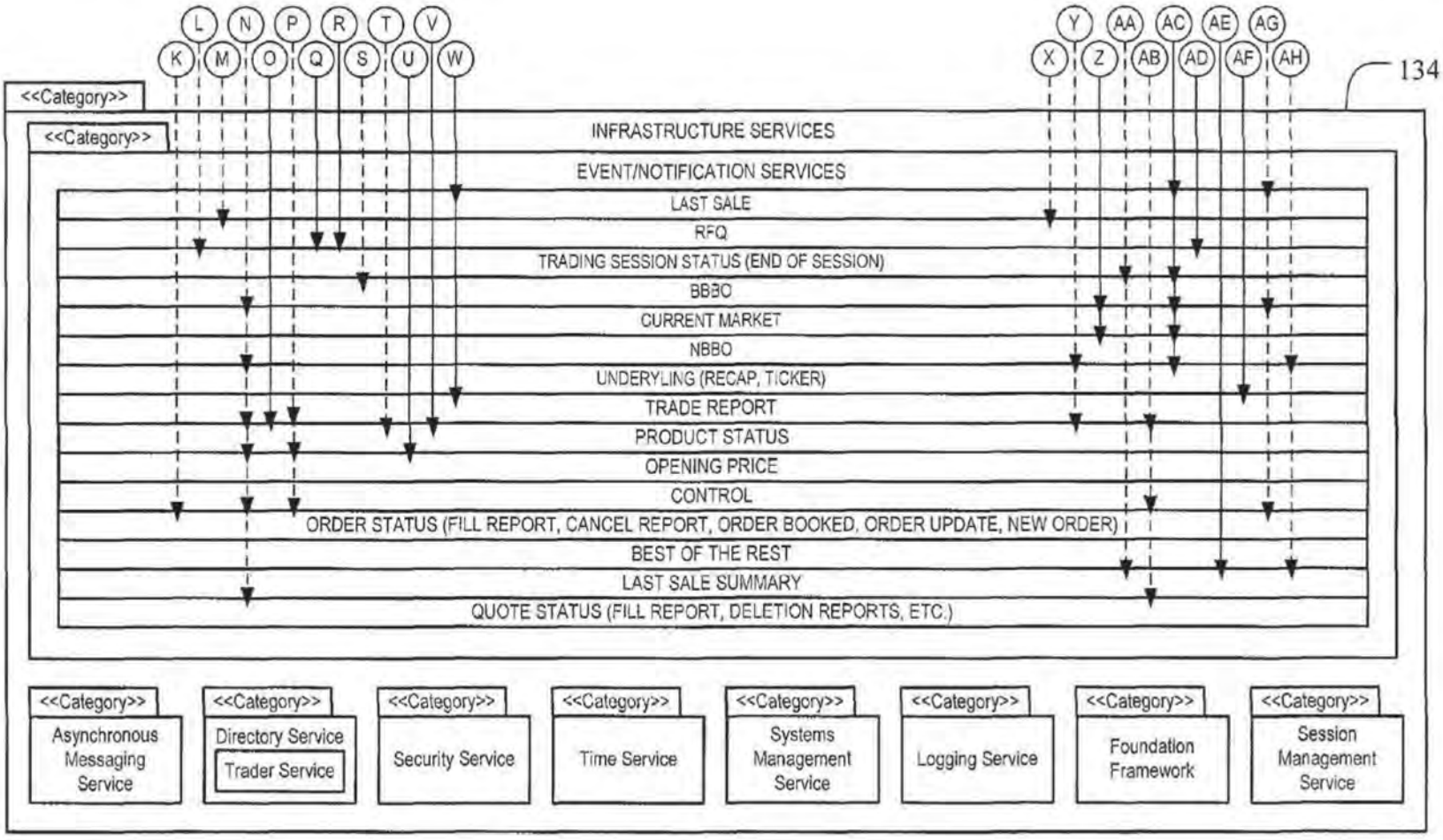
Fig. 2C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134
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INFRASTRUCTURE SERVICES
EVENT/NOTIFICATION SERVICES
LAST SALE
RFQ
TRADING SESSION STATUS (END OF SESSION)
BBBO
CURRENT MARKET
NBBO
UNDERLYING (RECAP, TICKER)
TRADE REPORT
PRODUCT STATUS
OPENING PRICE
CONTROL
ORDER STATUS (FILL REPORT, CANCEL REPORT, ORDER BOOKED, ORDER UPDATE, NEW ORDER)
BEST OF THE REST
LAST SALE SUMMARY
QUOTE STATUS (FILL REPORT, DELETION REPORTS, ETC.)
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Trader Service
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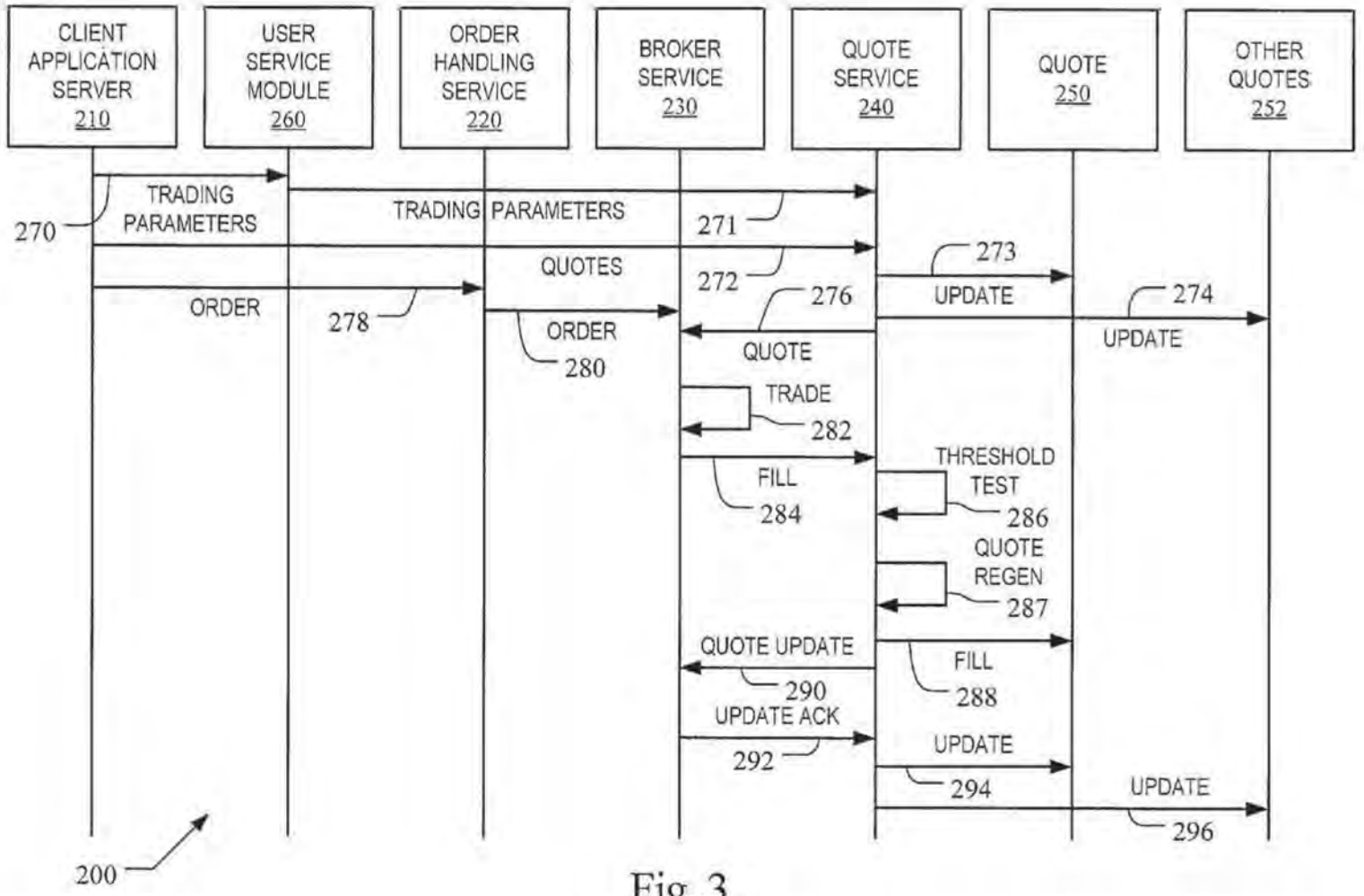
Session Management Service

Fig. 2D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USER SERVICE MODULE 260
ORDER HANDLING SERVICE 220
BROKER SERVICE 230
QUOTE SERVICE 240
QUOTE 250
OTHER QUOTES 252
TRADING PARAMETERS
270
TRADING PARAMETERS
271
QUOTES
272
273
UPDATE
274
UPDATE
ORDER
278
ORDER
280
276
QUOTE
TRADE
282
FILL
284
THRESHOLD TEST
286
QUOTE REGEN
287
QUOTE UPDATE
290
FILL
288
UPDATE ACK
292
UPDATE
294
UPDATE
296
200

Fig. 3

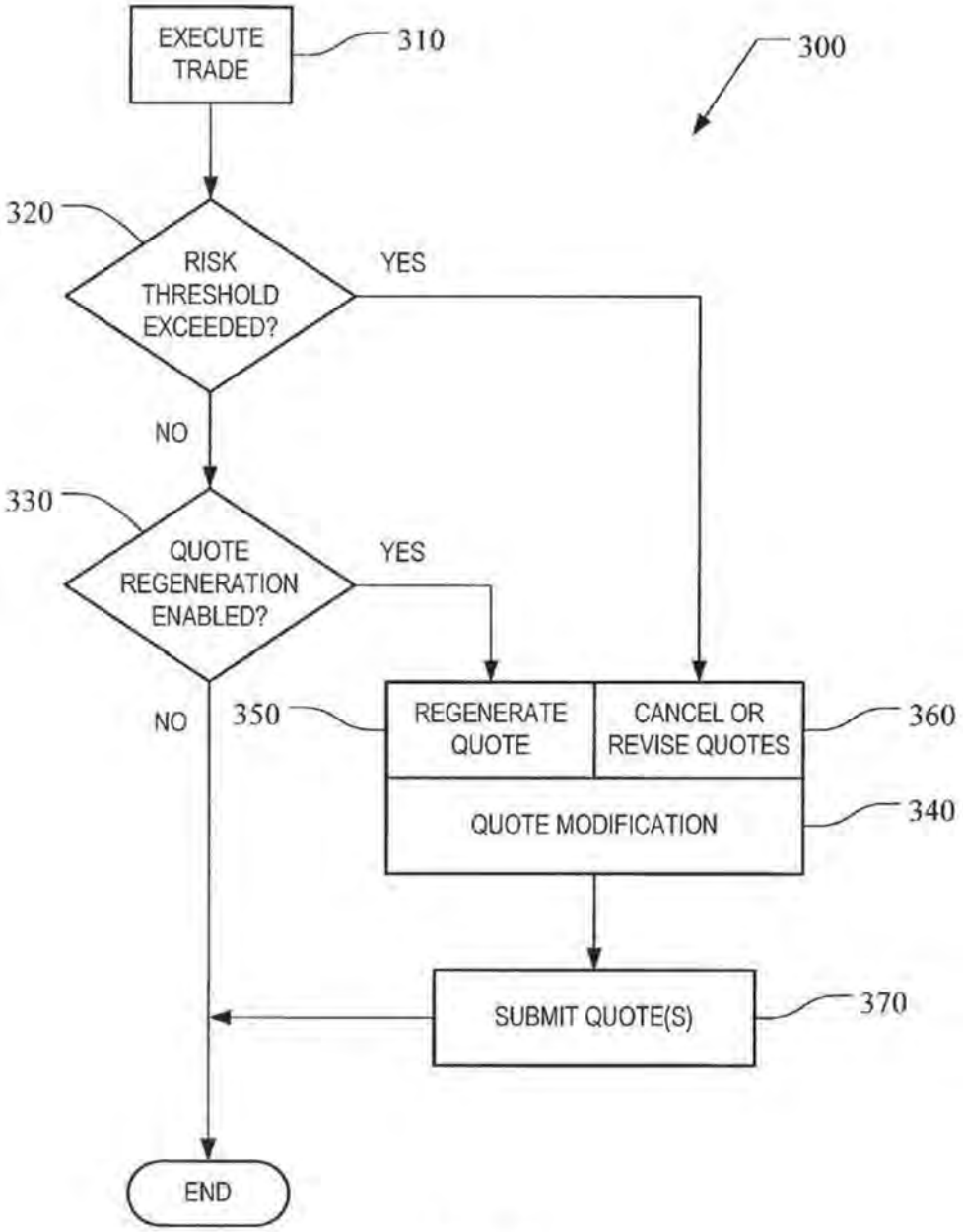

Fig. 4

CBM2013–00049
Exhibit ISE-1001, p. 9

AUTOMATED TRADING EXCHANGE SYSTEM HAVING INTEGRATED QUOTE RISK MONITORING AND INTEGRATED QUOTE MODIFICATION SERVICES

A. FIELD OF THE INVENTION

The present invention relates to financial trading systems. More specifically, it is directed to a method and device for market-maker risk management through automatic quote risk monitoring and quote modification in an automated trading system.

B. DESCRIPTION OF THE RELATED ART

1. Option Trading

Option contracts are traded publicly on many exchanges throughout the world. These securities, referred to generally as "options," convey certain rights to buy or sell an underlying stock, commodity, or other security at a fixed price for a specific period of time—until expiration for an American-style option or at expiration for a European-style option. All option contracts that trade on U.S. securities exchanges are issued, guaranteed and cleared by the Options Clearing Corporation (OCC). OCC is a registered clearing corporation with the SEC.

The potential loss to the buyer of an option can be no greater than the initial premium paid for the contract, regardless of the performance of the underlying stock. This allows an investor to control the amount of risk assumed. On the contrary, the seller of the option, in return for the premium received from the buyer, assumes the risk of being assigned the obligation to buy or sell the underlying security if the contract is exercised. Therefore, writing options can lead to large potential exposure.

Further background information may be obtained from the book "OPTIONS, Special Concepts and Trading Strategies," The Options Institute, The Educational Division of the Chicago Board Options Exchange, Second Edition, McGraw Hill (1995), the contents of which are incorporated herein by reference.

2. Open Outcry Trading and Automated Exchanges

Many trading systems utilize what is known as an open outcry method of trading. In the open outcry system, market-makers are required to make a two-sided market by providing a bid and offer quote in all option series. The market-makers typically communicate verbally or visually with contra traders indicating their willingness to buy and sell various quantities of securities. Because the market-makers have personal control over the types and number of contracts traded, they can adjust their trading strategies as their positions change. In this way, the market-makers can manage their exposure, or risk, associated with their holdings by adjusting their quotes to favor trades that would tend to hedge away unwanted exposure.

In an automated trading environment, a certain amount of control is lost when a market-maker has issued quotes in a large number of option series. The quotes are typically recorded in the automated and computer-based trading system, and matched up automatically with orders that enter the system electronically. With the proliferation of computer trading systems and increased communication speeds, the rate at which trades may be executed by an automated system far surpass the rate of trades that occur in an open outcry system. The speeds are such that the rapidity of trades may exceed the market-maker's ability to adapt his or her position. Specifically, one disadvantage of automated trading systems is that a number of automatic trades may occur within a very short time that result in an unacceptable risk being assumed by a market-maker. That is, the trades may occur so rapidly that the market-maker is unable to withdraw or modify his quotes in a timely manner.

There exist software tools that can analyze stock and option portfolios in close to real time. Market data is provided to the software analysis tools and used to evaluate the risk associated with stock and option portfolios. In addition, the tools may provide recommendations for trades and quotes and automated submission of those trades and quotes. However, even if a market-maker utilizes such a computer-implemented automated position analysis tool to revise or cancel quotes, the software tools may be unable to act in time given the speed at which an automated trading exchange system is capable of executing incoming orders. In particular, one aspect of existing exchange systems is that transactions are received and processed in the order received. Thus, even if a market-maker responds immediately using an automated software tool, the exchange may have a message queue containing additional orders that will be processed before the exchange system receives and processes the market-maker's quote cancellation request.

The result is that a market-maker who is willing to take on a predetermined level of risk must limit the number of quotes or the depth (quantity) of each quote to ensure that rapid trades do not result in an unacceptable aggregate risk, rather than issuing quotes having greater depth and breadth (where the filling of a single quote might reach the market-maker's risk limit). Thus, a market-maker's limited control over risk management may have the undesirable effect of hindering the liquidity of the market.

It would therefore be desirable to have a trading exchange system and method for automatically canceling, regenerating, or modifying quotes under certain trading conditions.

SUMMARY OF THE INVENTION

A method and apparatus for an automated trading exchange having integrated quote risk monitoring and quote modification services is provided. In accordance with a first aspect of the invention, an apparatus is implemented using at least one computer, having memory, a processor, and a communication port. The computer is configured to receive orders and quotes, wherein specified ones of the quotes are contained in a quote group, and have associated trading parameters such as a risk threshold. Note that not all received quotes are required to have trading parameters as described herein. Preferably, the quote group contains all the quotes belonging to an individual market-maker for a given class of options contracts, or possibly the quotes of two or more market-makers that have identified themselves as belonging to a group for the purposes of risk monitoring and quote modification. The computer typically generates a trade by matching the received orders and quotes to previously received orders and quotes, and otherwise stores each of the received orders and quotes if a trade is not generated. The computer then determines whether a quote within the quote group has been filled as a result of the generated trade, and if so, determines a risk level and an aggregate risk level associated with said trade. The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically modifies at least one of the remaining quotes in the quote group. The computer may also automatically regenerate quotes, that is, automatically issue new quotes when trades have occurred against previous quotes.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features and advantages of the present invention will be more readily appreciated upon reference to the following disclosure when considered in conjunction with the accompanying drawings, in which:

FIG. **1** depicts a preferred embodiment of the quote modification trading system;

FIGS. **2**A, **2**B, **2**C, and **2**D show the interconnection of various software modules associated with the quote risk monitoring and modification trading system;

FIG. **3** shows a sequence diagram of a preferred embodiment of the quote modification system; and

FIG. **4** shows a flowchart depicting the method of modifying quotes.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT(S)

With reference to FIG. **1**, a preferred embodiment of the system **100** utilized for trading and quote modification is described. The system **100** (also referred to herein as a screen-based trading system, or SBT system) includes a plurality of computers, which may be one or more workstations, servers, mainframes, or other computer hardware platforms that provide sufficient resources to meet the desired trading volume and desired transaction-processing rate. In the preferred embodiment shown in FIG. **1**, the system includes a number of computer clusters such as cluster **102** (although only one is depicted in FIG. **1**), where each cluster **102** handles trading for a number of securities, such as one or more classes of options. In the preferred embodiment, each cluster **102** is made up of two servers **104**, **106**. The servers **104**, **106** are preferably multiprocessor SUN **4500** servers available from SUN Microsystems of Palo Alto, Calif. SUN Enterprise™ servers or Starfire™ servers are a preferable alternative.

The servers **104** and **106** in cluster **102** communicate with a plurality of client servers **110**, **112** that are typically located at remote locations, such as at a brokerage house, but may also be located in the same facility as the clusters **102**. Network **108** facilitates communication between the clusters **102** and the client servers **110**, **112**. The network **108** is preferably a private LAN/WAN configuration, but a public network may be utilized, provided sufficient redundancies and message security are provided. Two such client servers **110**, **112** are shown in FIG. **1**. Each client server **110**, **112** may be provided with a predetermined message throughput rate into network **108**, where the throughput rate may be a maximum rate determined by various parameters, including the volume of orders sent by the client server **110**, **112**, the volume of quotes sent by the client server **110**, **112**, the number of option series for which quotes are provided, communication/connection fees paid by the brokerage house or other entity utilizing the client server **110**, **112**, the overall capacity of the trading system **100**, etc. The client servers **110**, **112** preferably communicate with other elements of the automated exchange system using a client application server module **210**, as further described below, running on client servers **110**, **112**.

Each client server **110**, **112** is capable of serving a number of clients, shown as terminals **114**, **116**, **118**, **120**, **122**, and **124** in FIG. **1**. The client terminals **114-124** may be "dumb" terminals; stand alone computing devices (PCs or workstations), or even portable wireless terminals. The client servers **110**, **112** may communicate with the client terminals **114-124** using a proprietary protocol or one of many standard

public domain protocols. The client servers **110**, **112** may include a web server or connect to a separate web server for processing tcp/ip, http, html, java, and the like, and provide access to client terminals **114-124** over the Internet in addition to (or as an alternative to) private LAN/WAN or Virtual Private Network access. For embodiments that include a webserver, the web server preferably utilizes common gateway interface scripts (cgi) to interface with the client application server **210**. In addition to cgi scripts, or as an alternative to cgi, other web server interfaces and server extensions may be utilized to provide communication between the web server and the application server **210**. The client servers **110**, **112** communicate with the users of terminals **114-124** by way of secure Internet communication protocols or by private LAN/WAN or VPN communication links. Thus the client terminals **114-124** may run dedicated proprietary software to communicate with the client server **110**, **112**, or may interface with client servers **110**, **112** via a standard web browser. The web browser may operate using built-in java scripts, or may also include specialized browser modules that are provided to the client terminals.

The automated exchange system **100** is comprised of the following five logical software modules: Presentation Services Graphical User Interface (GUI) **130** (FIG. **2**A); Application Services **210** (Client Application Server, Gateway) (FIG. **2**A); Business Services **132** (FIG. **2**B); External Integration Services **133** (FIG. **2**C); and, Infrastructure Services **134** (FIG. **2**D).

With reference to FIG. **2**A, the Presentation Services GUI module **130** is constituted by applications that interact with the exchange system **100** via the Member Interface (MI) API **135**. There are two types of client applications, those that provide a GUI to allow user interaction with the system directly and applications that automate trading functions.

An SBT (screen-based trading) GUI module **131** is responsible for displaying the contents of a particular model to the screen and updating the display if the model's contents change. This module **131** contains several GUI applications, one for each of the major classes of human actors that use the system **100**: traders, market-makers, clearing firm brokers, and system operators. The Trader GUI is used by regular traders. It consists of several GUI's for displaying and entering orders, and market data. The Market-Maker GUI is an extension of the Trader GUI and is used by market-makers. It consists of several GUI's for displaying and entering orders, quotes, and market data. The Clearing Firm Broker GUI is an extension of the Trader GUI and used by clearing firm brokers. It consists of several GUI's for forcing the logout of a market-maker and for setting a maximum order quantity for the quotes and orders of the clearing firm's market-makers. The system operation GUI is used by system operators and help desk operators. The autoquote system **161** runs on the market-maker's work station and is used by the market-maker to generate quotes for various option series.

The Application Services module **210** contains subordinate modules that forward requests initiated by human or automated actors, to be executed by the appropriate Business Services module(s) **132**. These applications submit requests to Business Services components **132**, notify clients of business events, and maintain user-specific views of information in the Business Services **132**. This module also encompasses a Member Interface (MI) API **135** that provides a single entry point to the system exposing the applications in the Application Services Module **210** (i.e., Trader, Market-Maker). In addition, the Application Services Module **210** maintains instantaneously updated views

that reflect the prevailing state of each actor's information in the Business Services module **132**.

The Trader Application module **136** has the following specific responsibilities: submit, cancel, update, and cancel/replace orders; submit requests for quotes; present the current status of the trader's orders; present fill and cancel reports; present Market Best Bids and Offers for selected products; set the trader's defaults and preferences; present Book Depths for selected products; and, present underlying quotes/last sales and news alerts.

The Market-Maker module **137** inherits the Trader App module's **136** responsibilities and adds the following: submit and modify market-maker quotes; present requests for quotes; set the market-maker's defaults and parameters; set autoquote parameters; submit autoquotes.

The Clearing Firm Broker module **138** inherits the Trader App module's **136** responsibilities and adds the following: assume control of a trader's privileges. A Clearing Firm Broker can force the logout of a market-maker; set a maximum order quantity for quotes and orders of the clearing firm's market-makers.

The BackOffice application **139** is responsible for reporting order status information. This can include fill reports, cancel reports and new order notifications. The Operations application **140** has the following responsibilities: start and shutdown the SBT system; start and stop trading of a product; change the status of a product's market (pre-open, open, close, halt, etc.); present logged system events; maintain SBT-specific trader information; maintain SBT-specific product information; maintain trading parameters (quote width, minimum market-maker order default size, required percent of responses to a request for quote (RFQ), maximum response time to an RFQ, etc).

The functionality of the Trader **136**, Market-Maker **137**, Clearing Firm Broker **138**, and Back Office **139** modules is exposed by a facade, the Member Interface (MI) Application Programming Interface (API) **135**. The Member Interface **135** exposes different subsets of functionality depending on the user that logged on to the system. The intention behind sharing a common API among the different trader classes is to allow workstations to service all of them. Separate API's may alternatively be used for the different user classes.

The Member Interface API **135** supports both SBT client applications and external applications owned by members. Members use the Member Interface API to link their existing computer systems to the exchange system **100**, to submit orders electronically and to automate trading. Likewise, market-makers use the API to submit autoquotes employing their proprietary systems, instead of the default autoquote application **161** provided by SBT.

The following system functions are preferably accessible through the API: session logon and logoff; market state inquiry and change notification; connection status inquiry and change notification; order entry, cancellation, and replacement; quote entry, cancellation, and replacement; RFQ notification; order status inquiry and fill notification; subscription to product markets; best market quotes notification; book "depth" inquire and change notification.

Referring now to FIG. **2**B, the Business Services module **132** contains the core functionality of the automated exchange system **100**. It includes components that correspond to the key business object model entities of the automated trading system such as members, orders, books, products, quotes, et cetera. In addition, it includes components to administer and operate the system **100**.

The Order Handling Service module **220** maintains the current state of all orders persistently. Specific operations may be exposed directly by Order objects **141**, bypassing the Order Handling Service **220**. Logically, Orders are components of this module. Specifically, the Order Handing Service **220** and Order components are responsible for: receiving and storing incoming orders (from SBT clients or TPF **156** (FIG. **2**C)); forwarding incoming orders to the Broker module for execution; receiving order state change notifications from the Broker and Order Book modules and updating stored orders with this information (the functionality is provided by exposing Orders, allowing the Broker and Order Book components to directly update the orders); sending fill reports to originating traders upon receiving fill notifications from the Broker and Order Book modules; receiving order cancellation requests and forwarding them to the Broker and Order Book modules (upon confirmation of a cancellation, notifying the originating trader of the result of the request and updating the stored state of the order); and receiving order cancellation/replacement requests and forwarding them to the Broker and Order Book modules (upon confirmation of the cancellation/replacement, notifying the originating trader of the result of the request and updating the stored state of the order).

The Broker Service module **230** is responsible for executing the following types of orders: limit, market, all or none, fill or kill, immediate or cancel, stop, stop limit, and spread. Upon trade execution, the Broker Service **230** is responsible for notifying the Trade Service module **143** of all the orders matched (all parties to the trade) in the trade. It is also responsible for notifying the Order Handling Service (i.e. Orders) **220** and Market-Maker Quote Service (i.e. Quotes) **240** of the fills.

The responsibilities of the Order Book Service module **142** are: cooperate with the Broker Service **230** in calculating the opening price during a product's pre-opening period; acknowledge that an order was accepted by publishing an event consumed by the Trader application **136** which originated the order; cancel and cancel/replace resting orders; upon changes to the top of the book, publish the new Book Best Bid Offer (BBBO) and last sale.

The responsibilities of the Trade Service module **143** are: receive trade notifications from the Broker Service **230**; format trade reports; store trade reports; and forward trade reports to trade match (via TPF **156**).

The Market-Maker (MM) Quote Service module **240** is responsible for: receiving requests for quotes (RFQs) from traders; submitting RFQs to market-makers assigned to the product for which the quote was requested (by publishing in the RFQ event channel); receiving and logging market-maker responses to RFQs (market-maker quotes); upon receiving a market-maker quote, saving it persistently and submitting them to the Broker Service module **230** for execution; sending fill reports to originating market-makers upon receiving fill notifications from the Broker and Order Book modules; canceling or updating a Market-Maker quote upon receiving a request from the originating market-maker by submitting the request to the Broker/Order Book; canceling or updating or regenerating Market-Maker quotes upon receiving a fill report; upon inquiry, providing the history of the quotes submitted by a market-maker.

The Product Service module **144** maintains all product-related information. In order to perform its responsibilities, the Product Service module **144** downloads, and preferably caches, product information from TPF **156** and TIPS **157**. The User Service module **260** maintains all user-related information, both specific to SBT and contained in the Membership System. It provides a unified interface to SBT

components accessing user information, hiding the actual location of the maintained data, thus simplifying client logic.

The User Service module **260** maintains the information of traders, market-makers, clearing firm brokers, operators, help desk personnel, back-office personnel. In one embodiment, the data is cached for performance reasons and the data is synchronized from the TPF **156** source.

The Trading Session Service module **145** maintains all business day and trading session-related information and manages the different states of a trading session, e.g. open, closed, and halted. Products that are processed/traded in each trading session are also kept at this service. In order to perform these responsibilities, the Product Service module **144** downloads trading session and product information from TPF **156**, as well as monitor events that affect products traded within a session.

The Product State Service **146** is responsible for coordinating product state changes for all products, e.g. pre-opening, opening, trading, halting, closing, and post-closing. It works closely with the Broker Service **230** to insure that state changes occur in a timely fashion. The service **146** monitors events that affect products traded, such as monitoring the underlying market to detect when the primary exchange opens, closes or halts trading a product. The Product Configuration Service **147** is responsible for providing the location of where a product is processed/traded. This information is primarily used to route product-specific requests (e.g. orders) for processing. The Order Status Service **148** provides subscription and notification services related to orders (i.e., fill reports, cancel reports, order accepted by book, etc.).

The Quote Status Service module **149** provides subscription and notification services related to quotes (i.e. fill reports, deletion reports, etc.) The service **149** preferably replaces the use of event channels for quote status reporting, providing a more secure mechanism for status delivery. The Market Data Service **150** maintains a current snapshot of market data, in addition to publishing market summary data. The module also provides an interface to clients to query historical market data.

The Best Quote module **151** is responsible for calculating the market best (aggregate quantities of buy and sell orders at the best price) for each product and sending them to TPF **156** (which in turn forwards them to the Options Price Reporting Authority) for public dissemination. In addition, it is responsible for calculating and disseminating the National Best Bid Offer (NBBO). In order to provide this information, the Best Quote module **151** subscribes to the event channel referred to herein as the Best of the Rest channel to obtain the current best quote from competing exchanges. The Best Quote module **151** then determines the source of the NBBO, whether it is from the present exchange or a competitor, and publishes the results to the Best Quote event channel, of which the TPF Adapter **152** is a subscriber.

Referring now to FIG. **2**C, the External Integration Services module **133** includes adapters **152**, **153**, **154**, and **155**, that map the interaction paradigms of external systems to the ones in the system **100** architecture. The adapter modules "adapt" (or "wrap") the native legacy interfaces to interfaces appropriate in the SBT environment. The TPF (Transaction Processing Facility) module **152** contains the adapter to allow SBT and TPF **156** to interact. TPF data is received, remoduled, and broadcast/delivered to the appropriate components within SBT. Conversely, SBT data is received, either through direct invocation or event consumption, remoduled, and sent to TPF **156** using its native interface.

The Membership Adapter **154** translates requests for member information received from SBT components into requests to the Membership System **159** and returns the results after reformatting.

The TIPS Adapter **155** subscribes to TIPS **157** to receive the external market data needed in the SBT environment, including underlying market data and the Best of the Rest of options listed in SBT. The Events Service (FIG. **2**D) notifies the TIPS Adapter **155** of consumer subscriptions so that it can propagate these subscriptions back to TIPS **157**. Once subscribed, the TIPS Adapter **155** reformats the market data received from TIPS **157** and publishes it for consumption by SBT components. Another responsibility of this adapter **155** is to publish underlying product state events when external markets change their states, for instance when they open, halt, close, etc.

The Trade Match Adapter **153** receives SBT data and forwards it to TM **158**. The TM Adapter **153** handles the following data flows: Trade Report (SBT to TM)—SBT reports all the parties to a trade to TM **158**.

Referring now to FIG. **2**D, the Infrastructure Services module **134** contains commercial "off-the-shelf" software and extended infrastructure services that provide enterprise-wide support to various other external systems. One mechanism by which the SBT system components interact with each other is by supplying and consuming events, implemented as a publish/subscribe pattern. The following list provides a brief description of the event flows/notification services (messaging services) shown in FIG. **2**D.

RFQ—the Market-maker (MM) Quote Service supplies RFQ events consumed by the Market-Maker Application.

BBBO—the Order Book supplies Book Best Bid Offer (BBBO) events consumed by the Best Quote Service.

NBBO—the Best Quote Service supplies National Best Bid Offer (NBBO) events consumed by the Trader Application, and Market Data Service.

Current Market—the Best Quote Service supplies Current Market Best events, containing a product's best quote, consumed by the Market Data Service and Trader Application. The best quote indicates if the exchange has the best quote.

Best of the Rest—the TIPS Adapter component supplies best-of-the-rest events consumed by the Best Quote Service.

Last Sale—the Trade Service supplies last sale events consumed by the Market Data Service **150** and TPF Adapter **152**.

Last Sale Summary—the Market Data Service **150** component supplies last sale summary events consumed by the Trader application.

Logging—the Logging Service Proxy component supplies Log Service events consumed by the Log Service component.

System Management—the Foundation Framework supplies System Management events consumed by the System Management component.

Instrumentation—the Instrumentation Service component supplies Instrumentation events consumed by both the System Management component and the Log Service component.

Underlying Ticker—the TIPS Adapter supplies Underlying ticker events (prices, quotes, last sales, news alerts) consumed by the Trader Application and the Product Service.

Underlying Recap—the TIPS Adapter supplies Underlying summary events (high and low prices, volume) consumed by the Market Data Service and Trader Application.

Trade Report—the Trade Service supplies Trade Report events consumed by the TPF Adapter **152**.

Product Status—the Product Service **144** and Product State Service **146** supply Product Status events (State, Price Adjustment, and Update) events consumed by the Trader application, Order Handling Service **220**, and TPF Adapter **152**.

Trading Session Status—the Trading Session Service **145** supplies Trading Session State events consumed by the Operations Application **140** and Help Desk application **160**.

End of Session Summary—the Trading Session Service supplies End of Trading Session Status events.

Opening Price—The Broker Service module **230** supplies Opening Price events consumed by the Trader Application **136**.

Control—the Operations **140** and Help Desk **160** applications supply Control events, possibly through the System Management component, consumed by Business Services **132** and External Integration Services **133** components.

Order Status—the Order Handling Service **220** (Order) supplies Fill Report, Cancel Report, Updated Order, New Order, and Order Accepted by Book events consumed by the Order Status Service **148**, and TPF Adapter **152**.

Quote Status—the MM Quote Service **240** (Quote) supply Fill Report, and Delete Report events consumed by the Quote Status Service **149**.

In accordance with a preferred embodiment, there are four major tiers of the application software. The business services **132** handle all the SBT order matching, execution and reporting functionality. It provides the repository for all SBT information data. The application services **210** handle the application presentation and act as the application front end to the business services. Different views of the business services **132** and collaboration of business objects are grouped together and are presented to the user based on logon authentication and authorization level. The two tiers communicate to each other by two supported tiers: the infrastructure services **134** and external integration services **133**. The infrastructure services **134** provide a seamless integration between the application services **210** and business services **132**. The external integration services **133** provide the access to the external system.

With reference to FIG. **3**, a sequence diagram **200** for a preferred embodiment of the automated exchange system **100** is shown. The system **100** includes a client application server **210**, an order handling service module **220**, a broker service module **230**, a quote service module **240**, a user service module **260**, and quote objects **250** and **252**. The service modules **220**, **230**, **240**, **260** and objects **250**, **252** are preferably software modules running on clusters **102**, or on one or more interconnected computers. The software modules are preferably written in an object-oriented programming language and are compiled to run on the clustered computers **102**. Preferably, the software utilizes the C++ language, the Java programming language, or other object-oriented language. Alternatively, any suitable software language may be used to implement the system, as will be understood by one of ordinary skill in the art. The modules also interact with a database program used for storing data and other system and user information. In the preferred embodiment an Oracle database system is used.

The client application server **210**, as discussed above, runs on client servers **110**, **112**, and provides an interface to one or more clients. The client server **110**, **112** may include one or more application modules, depending upon the intended users of the servers **110**, **112**. For example, the client servers **110**, **112** preferably include at least one of a market-maker application, a trader application, a back-office application, or a member interface. The client servers **110**, **112** also preferably utilize a user authentication and role-based security model to control access to the various application modules.

The client server **110**, **112** may also include modules such as a help desk application, an operations application, and a Clearing Firm Broker (CFB) module. The CFB module may be configured to allow a Clearing Firm to set maximum volume limits on a per-class basis. The Help Desk module is preferably enabled for use on client servers that provide connectivity to exchange management personnel. The Help Desk provides a utility to force a user to logout of the system.

The order handling service **220** forwards orders to the appropriate broker service module **230** that handles the class of options to which the individual orders relate. If the broker service module **230** cannot execute the order immediately, it routes it to the order book service module, which maintains the current state of all pending orders and quotes. The order handling service module **220** receives order information from various sources, including brokers, traders, market-makers, etc. The orders may enter the system from a client application server **210** or through an alternative interface such as TFP adapter **152**, which is a connection that allows a pre-existing automated order handling system such as TPF system **156**, to access the present system.

The broker service module **230** is responsible for executing various types of orders, including limit, market, all or none, fill or kill, immediate or cancel, stop, stop limit, and spread orders. Preferably, there are numerous broker service modules **230** running on the exchange server **104**, or on the interconnected computers in the cluster **102**, where each broker service module **230** handles trades for a subset of products offered by the exchange. For example, there is preferably a broker service module **230** for each class of option contracts. The broker service module **230** thus matches incoming orders to other orders or to quotes supplied by market-makers to complete a trade, indicated by line **282** in FIG. **3**.

The broker service module **230** also receives quotes from the quote service **240**, discussed below. The broker service module **230** attempts to execute a trade **282** by matching incoming quotes to orders or to other quotes stored by the order book service module **142** in the order book. Note that for purposes of trade execution **282**, quotes are treated by the exchange system **100** as if they were orders. Thus, when the broker service module **230** receives a quote that it cannot match to an existing order or quote, it sends the quote to the order book for storage with other unfilled quotes and orders. Preferably, quotes differ from regular orders in that a quote may be two sided, having a bid and an offer price, and that each market-maker may only have one quote per product in the system.

To facilitate the order matching process of trade execution **282**, the broker service module **230** has direct access to orders stored in the order book by the order book service module **142**. Preferably, when the incoming order is matched to an existing quote supplied by the quote service module **240**, the broker service module **230** provides the quote service module **240** with details of the trade.

The quote service module **240** manages the quotes supplied by market-makers via client application service module **210**. The quote service module **240** submits the quotes to the broker service module **230** for execution. The quote service module **240** ensures that each individual market-maker has only one quote per product in the system at any

given time. When a market-maker enters a new quote on a product for which he already has an outstanding quote, the quote service module preferably determines whether there is already an existing quote in the system for that market-maker and, if so, informs the broker service module **230** that the pre-existing quote is to be cancelled. The quote service module **240** submits the new quote to the broker service module **230** only after it has received acknowledgement from the broker service module **230** that the pre-existing quote has been cancelled.

The broker service module **230** issues fill reports to notify various other modules, and ultimately the trading entities, that the trade was executed. Upon notification of a fill **284** from the broker service module **230** (or the order book module), the quote service module **240** informs the quote object **250**. In turn, the market-maker is notified of the fill via the exchange's reporting system. The quote service module **240** also cancels or updates a market-maker quote upon receiving a request from the originating market-maker by submitting the request to the broker service **230**. The quote service module performs this by first informing broker service module **230** that the pre-existing quote has been cancelled. The broker service module **230** then removes the quote from the order book and confirms to the quote service **240** that the quote has been cancelled. The quote service **240** then submits the new quote (if one exists) to the broker service module **230**.

With respect to FIG. **3**, a preferred sequence of events and messages will be described. Market-Makers log into a client application server module **210** and access the user service module **260**. The market-maker communicates with the user service module **260** through a terminal, such as a workstation or wireless handheld unit. As shown by line **270**, trading parameters, or quote parameters, are sent to the user service module **260**. Upon initialization of the quote service, or upon login of a new market-maker, various trading parameters are provided to the quote service module **240** as shown by line **271**. The trading parameters may include a risk threshold, a quote regeneration indicator, a quote regeneration increment, a quote modification indicator, and a quote modification increment. The parameters may include numerous sets of thresholds, indicators, and increments, preferably one such set for each class for which the market-maker is providing quotes.

The quote service module **240** receives quotes from market-makers as shown by line **272**, and provides these quotes to the quote objects **250**, **252**, as shown by update lines **273**, **274**, and to the broker service module **230** as shown by line **276**. As mentioned above, the quote service module **240** will not forward updated quotes (as opposed to new quotes) to the broker service module **230** before first canceling old quotes.

Orders received by the client application server **210** are routed to the order handling service **220** as shown by line **278**. The order is then forwarded to the appropriate broker service **230** as shown by line **280**. The broker service module **230** attempts to execute every order or quote received with the best order (or quote) in the book as shown by line **282**. When a trade is executed, a fill report is issued to the quote service module **240** as shown by line **284**. The quote service module **240** then analyzes the trade and determines whether the market-maker's risk threshold has been exceeded, as shown by line **286**. The threshold test will be described in further detail below. A fill report is sent to the quote object **250** as shown by line **288**. The quote object **250** then informs market-maker of the fill through the use of a trade report service module (not shown).

In addition, at steps **286** and **287**, the quote service module may modify quotes in response to the trade in accordance with the market-maker's trading parameters, as discussed below. The quote service module then reports the new quotes to the broker service module **230** as shown by line **290**. The broker service **230** acknowledges the quote updates as shown by line **292**. If the broker service **230** has already processed additional trades against the original quote, then the broker service module **230** would respond with a "too late to cancel" message. Once the update acknowledge has been received, the quote service module **240** updates the quote objects **250**, **252**, as shown by lines **294**, **296**. The quote objects then inform the market-maker that its quotes have been updated.

Risk Measurements and Risk Thresholds

In a preferred embodiment of the automated trading system **100** having integrated order modification and quote risk monitoring, the aggregate risk of a market-maker's recent trades is calculated after each trade. The measurement preferably includes either calculating an equivalent stock position, i.e., a net delta (by, for example, summing delta values for all contracts traded by the market-maker associated with the option series in the class), or calculating a net gamma, theta, or vega.

In particular, the aggregate risk measurement is preferably the net delta of all the trades for a specific market-maker or a designated group of market-makers in a given class in a given period of time. The quotes in a given class submitted by a market-maker (or a group of market-makers) are referred to herein as a quote group. The rules for delta calculations are as listed below:

Calls (delta value Δ is positive)
- Market-maker selling
- Market-maker position will be Negative Delta
- Market-maker buying
- Market-maker position will be Positive Delta

Puts (delta value Δ is negative)
- Market-maker selling
- Market-maker position will be Positive Delta
- Market-maker buying
- Market-maker position will be Negative Delta

The aggregate risk net delta is defined as:

$$\Delta_{NET} = \sum_i S_i \cdot \Delta_i \cdot U_i \cdot K_i, \qquad (1)$$

which is the summation for i trades of the product of S, the sign of the trade, where S is positive when a market-maker buys and negative when a market-maker sells, Δ (delta), which is rate of change of the price of the individual series with respect to the stock, and ranges from −1.0 to 0 for puts and 0 to 1.0 for calls, U, which is the unit of trade, i.e. the number of shares, and K, the number of contracts traded by the market-maker.

The aggregate risk measurement is preferably based on the net delta Δ_{NET} for the entire class of options, which is the sum of all the deltas for a given market-maker's trades in all series of a class. The delta contribution for each trade is calculated every time a trade occurs for any series in the class. The aggregate risk is then calculated by summing delta contributions from only the most recent trades. The values for the theoretical deltas Δ_i are preferably obtained by

an autoquote system (not shown) associated with the exchange system **100**, and more particularly with the business services package **132**.

Autoquote systems provide pricing information, and specifically theoretical delta values Δ_i, using well-known algorithms that utilize standard parameters, as is understood to those of skill in the art. Most of the parameters associated with calculating an individual series delta value are objective data, such as the date, strike price, the price of the underlying security, etc. Other autoquote parameters have acceptable default values that may be used, such as using the broker loan rate for the interest rate, etc. One parameter that may be more subjective among individual market-makers is the volatility parameter. Thus, the system **100** may be designed such that each quote submitted by a market-maker includes a volatility field to be used by the system in determining the individual theoretical delta value Δ_i. The theoretical delta value Δ_i may then be calculated either as part of the threshold test, or may be periodically updated at a rate sufficient to provide a fairly accurate delta value Δ_i. In this way, the system **100** provides the market-maker with further control over the quote risk monitoring system.

Because the exchange quote modification service is intended to address increased risks associated with a rapid sequence of trades, older trades need not be included because the market-maker has had an opportunity to manually intervene and modify his quotes. Thus, the aggregate risk measurement may be based on the last N trades, where N is a trading parameter specified by the market-maker, or may be based on trades occurring within a specific time frame. The duration of the time frame may be specified by the market-maker by providing a time window parameter t_K, which is included as a trading parameter. Alternatively, a default value for t_K may be used.

Alternatively, the risk threshold and risk measurement may include an aggregate gamma measurement. Gamma is known to those of skill in the art to be the rate of change of the delta parameter with respect to the rate of change of the underlying security, such as the stock. An aggregate gamma measurement provides an indication of the rate at which an aggregate delta measurement will change. Net gamma values are negative when a market-maker is a net seller of contracts, and positive when a market-maker is a net buyer of contracts. As a further alternative, either theta, which is the rate at which option prices change over time, or vega, which is the change in an option contract that results from a change in its volatility, may be included.

The market-maker may provide a single threshold Δ_{NETMAX} such that if the absolute value of the aggregate risk exceeds the threshold, then the quotes are modified according to the rules set forth below. The market-maker may also provide positive and negative thresholds Δ^{Δ}_{NETMAX} and Δ_{NETMAX} to accommodate a market-maker's pre-existing risk bias.

In an alternative preferred embodiment, the market-maker's risk is determined by calculating the net contract volume traded within a specified time. The net contract volume K_{NET} may be calculated by using equation (1) above, with the exception that the delta value is replaced by the sign of Δ, or ±1, where calls are positive 1, and puts are negative 1:

$$K_{NET} = \sum_i S_i \cdot \text{sign}(\Delta_i) \cdot U_i \cdot K_i, \text{ for each trade, } i. \quad (2)$$

The result is that the volume of each trade is treated as a positive or negative value, depending upon the nature of the trade-selling calls and buying puts have negative contributions, and buying calls and selling puts have positive contributions. The sum of the trades is then calculated to provide a net difference between the number of short calls plus long puts and long calls plus short puts. Thus, the market-makers may specify a threshold in terms of a maximum net contract volume offset, K_{NETMAX} (or positive and negative thresholds K^{+}_{NETMAX} and K^{-}_{NETMAX} to accommodate a market-maker's pre-existing risk bias). As stated above, the system may be configured to also allow the market-makers to specify a time window parameter t_K that specifies which trades should be included in the risk calculation. Thus, only the contracts K that have been executed within the previous t seconds will be included in equation 2. Alternatively, the system may be configured to specify i, the number of previous trades to include in the risk calculation.

In still further embodiments, the aggregate risk measurement may be simplified by calculating the total number of put or call contracts (or deltas) that have been sold or bought within a given time frame or within that last N trades. Thus, for example, when a market-maker has just sold a put, the quote service module **240** may calculate the total number of puts sold (or the delta due to all the puts sold) within the given trading window and compare it to a threshold. If the next trade is a call purchase, then the system would calculate the contracts or deltas for the calls purchased. Thus, if any of the four aggregate volume quantities (buying calls, selling calls, buying puts, selling puts) exceeds a threshold (within a certain time period, or certain number of trades), the quote modification module **340** modifies the quotes appropriately. Alternatively, the quote service module **240** may calculate the total calls bought plus puts sold, and the total calls sold plus puts bought, and notify the quote modification module **340** if either of these aggregate values exceeds the threshold. As a further alternative, the quote service module may use a weighting scheme to calculate aggregate values described above. Specifically, in-the-money options (options with intrinsic value) may be weighted more heavily than at-the-money or out-of-the-money options. In one preferred method, the in-the-money options are weighted with a factor of two, at-the-money options are weighted with a factor of one, and out-of-the-money options are weighted by a factor of one half. These simplified risk measurement and threshold tests perform adequately due to the nature of trading activities that typically result in large risk exposure.

It should also be noted that the market-makers may be grouped together for purposes of risk exposure analysis. That is, the total risk may be calculated based on the trades of one or more market-makers. The market-makers provide a group identification parameter(s) indicating which other market-makers' trades should be included in the risk calculation. In this manner, market-makers acting in concert on behalf of a single organization may coordinate their quote modification.

Automatic Quote Modification

The quote service module **240** of the exchange system **100** includes a quote modification service module **340**. The quote modification service module **340** may be implemented as part of the quote service module **240**, or may be a separate service module. It may also take the form of a separate quote factory module for generating new instantiations of quote objects. The quote modification service module **340** performs quote modification by preferably automatically revising, canceling, or regenerating quotes. The quote modifica-

tion service module **340** resides on the exchange system computer **104**, **106**, or computer cluster **102**. The quotes are modified by the exchange system in an automatic manner that does not require further input from the market-maker in the form of quote cancellation requests and submission of new quotes by the market-maker or his computer. In this way, the exchange system performs quote modification immediately and without the transmission delays inherent in communication systems and without delays associated with processing queued cancellation requests received from a remote location.

If the quote service module **240** determines that the threshold(s) have been exceeded, the quote service module **240** determines revised quotes and forwards them to the broker service module **230** and the quote objects **250**, **252**. The revised quotes can take numerous forms. In a first embodiment, the quote service module **240** revises quotes by canceling all outstanding quotes in the class, thereby preventing any further trades from executing and giving the market-maker time to provide revised quotes. In this embodiment, the quote service module **240** sends quote update messages **290** in the form of cancellation messages to the broker service module **230**. The broker service **230** then removes those quotes from the electronic book. Because the threshold test is performed by the exchange system **100** after each trade, the cancellation messages are therefore preferably processed before any further trades can be executed. This is possible because the cancellation requests are not sent from a remote node on a wide area network, such as a market-maker's computing platform, but are generated by the exchange system **100**. This provides the advantage of eliminating a cancellation message queue, as would be used when sending cancellation requests from a remote node, thereby improving quote update times and providing risk management.

In a second embodiment, the quote service module **240** revises quotes by reducing the quantity associated with the existing quotes in the class thereby reducing the amounts of potential further trades and reducing the market-maker's exposure to more risk. The market-maker may specify the amount of the volume decrease by way of an increment value. In this embodiment, the quote service module **240** sends quote updates **290** by first sending quote cancellation messages to the broker service module **230**, and after acknowledgment, sending the revised quotes to the broker service module **230** for execution or booking. Again, because the threshold test is performed by the exchange system **100** after each trade, the cancellation messages are therefore preferably processed before any further trades can be executed. As above, this is possible because the cancellation requests are not sent from a remote node on a wide area network, such as a market-maker's computing platform, but are generated by the exchange system **100**.

In a third embodiment, the quote service module **240** revises quotes by decreasing the bid and offer values of some quotes and increasing others in an attempt to cancel some of the risk already assumed by the market-maker. The quote service **240** does this by automatically adjusting quotes to favor trades that will tend to provide offsetting risk. Specifically, if the threshold (K_{NETMAX} or Δ_{NETMAX}) has been exceeded by a high positive-valued net delta (or K), then the net delta (or K) may be offset by trades having a negative delta (or K). As set forth above, those trades would include selling calls and buying puts. Similarly, if the threshold has been exceeded by a high negative-valued net delta (or K), then the aggregate risk may be offset by trades having a positive delta (or K), or by selling puts and buying calls. Of course, to produce the desired trades, the lowering of offer values of quotes will tend to result in more selling activity by the market-maker, and the raising of bid values will result in more buying activity by the market-maker. In this embodiment, the modification increment is specified by an increment value. As in the previous embodiment, the quote service module **240** sends quote updates **290** by sending quote cancellation messages to the broker service module **230**, and after acknowledgment, sending the revised quotes to the broker service module **230** for execution or booking. Again the automated risk monitoring system and quote modification service of system **100** provides advantages in that the market-maker need not cancel previous quotes and submit new quotes while still being exposed to the possibility of further trades being executed.

The quote service **240** may also modify quotes by regenerating the just-filled quote. This may be performed even if the market-maker's risk threshold has not been exceeded. The market-maker is able to specify quote regeneration parameters via client application server **210** that are stored in the user service module **260**. The parameters specify which products are enabled for quote regeneration, and the extent to which the quotes are to be regenerated. The market-maker may therefore specify, on a product-by-product basis, how many times the quotes are to be regenerated after each quote has been filled. This is referred to herein as the regeneration number parameter. The market-maker may also specify whether the regenerated quotes are to have the same bid and offer values, or are to be backed-off from the previous trade. This parameter is referred to herein as the regeneration increment. That is, for a two-sided quote, if the market-maker has just sold a quantity of contracts at his offer price, the regenerated quote may have a higher offer value. Preferably the bid value is also raised accordingly to maintain a desired or required spread in bid and offer quotes. If, on the other hand, the market-maker has just bought a quantity of contracts at his bid price, the regenerated quote may have a lower bid value. The market-maker also has the option of specifying on a per-class basis the values of the regeneration number parameter and the regeneration increment parameter. The quote regeneration is preferably not performed if the market-maker risk threshold has been exceeded, unless the market-maker has specifically selected quote revision in the event the risk threshold has been exceeded.

With reference to FIG. **4**, the method of quote modification **300** will be described. Upon execution of a trade at step **310**, the quote service module **240** at step **320** checks to see whether the individual market-maker's risk threshold has been exceeded. As mentioned above, the risk measurement and threshold test may be performed using a variety of methods, and certain market-makers' trading activities may be combined for the purposes of risk exposure. If the threshold has not been exceeded, then at step **330** the quote service module **240** preferably checks to see whether the market-maker whose quote has been executed has indicated the desire to have his quotes regenerated. If not, then the process has completed. In the event that the result of either inquiry **320**, **330** is affirmative, then the quote service **240** modifies the quotes with the quote modification module **340** as described above.

Quote modification module **340** includes quote regeneration module **350** and cancel or revise quote module **360**. As mentioned above, the quote modification module **340** may be integral to quote service module **240**, or may be included in a quote factory module, or may be a separate service module. The quotes are regenerated, cancelled, or revised,

for example as described above, and submitted as shown in step **370** to the broker service module **230** for execution.

Preferred embodiments of the present invention have been described herein. It is to be understood, of course, that changes and modifications may be made in the embodiments without departing from the true scope of the present invention, as defined by the appended claims. The present embodiment preferably includes logic to implement the described methods in software modules as a set of computer executable software instructions. A Central Processing Unit ("CPU"), or microprocessor, implements the logic that controls the operation of the transceiver. The microprocessor executes software that can be programmed by those of skill in the art to provide the described functionality.

The software can be represented as a sequence of binary bits maintained on a computer readable medium including magnetic disks, optical disks, and any other volatile or (e.g., Random Access memory ("RAM")) non-volatile firmware (e.g., Read Only Memory ("ROM")) storage system readable by the CPU. The memory locations where data bits are maintained also include physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the stored data bits. The software instructions are executed as data bits by the CPU with a memory system causing a transformation of the electrical signal representation, and the maintenance of data bits at memory locations in the memory system to thereby reconfigure or otherwise alter the unit's operation. The executable software code may implement, for example, the methods as described above.

It should be understood that the programs, processes, methods and apparatus described herein are not related or limited to any particular type of computer or network apparatus (hardware or software), unless indicated otherwise. Various types of general purpose or specialized computer apparatus or computing device may be used with or perform operations in accordance with the teachings described herein.

It should be understood that a hardware embodiment may take a variety of different forms. The hardware may be implemented as an integrated circuit with custom gate arrays or an application specific integrated circuit ("ASIC"). Of the course, the embodiment may also be implemented with discrete hardware components and circuitry. In particular, it is understood that the logic structures and method steps described herein may be implemented in dedicated hardware such as an ASIC, or as program instructions carried out by a microprocessor or other computing device.

The claims should not be read as limited to the described order of elements unless stated to that effect. In addition, use of the term "means" in any claim is intended to invoke 35 U.S.C. §112, paragraph 6, and any claim without the word "means" is not so intended. Therefore, all embodiments that come within the scope and spirit of the following claims and equivalents thereto are claimed as the invention.

We claim:

1. A method of modifying quotes in an automated exchange trading system comprising the steps of:

receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;

generating a trade by matching said received orders and quotes to previously received orders and quotes;

storing each of said orders and quotes when a trade is not generated;

determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;

comparing said aggregate risk level with said risk threshold; and,

automatically modifying at least one of the remaining said specified ones of said quotes in the quote group if said threshold is exceeded.

2. The method of claim **1** wherein the quotes are stored in a quote data structure containing a plurality of quotes fields and at least one risk threshold field.

3. The method of claim **2**, wherein the plurality of quote fields comprises a bid quote field and an offer quote field.

4. The method of claim **2**, wherein the data structure further comprises a group indicator field.

5. The method of claim **2**, wherein the data structure further comprises a quote modification increment field.

6. The method of claim **2**, wherein the data structure further comprises a quote regeneration increment field.

7. The method of claim **2**, wherein the data structure further comprises an owner field.

8. A method of modifying quotes in an automated exchange trading system that receives orders and quotes from remote computers, matches the orders and quotes to generate trades, and stores orders and quotes that are unmatched, comprising the steps of:

receiving trading parameters comprising a risk threshold;

associating said trading parameters with specified ones of received quotes;

determining whether a quote having associated trading parameters has been filled as a result of a generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;

comparing said aggregate risk level with said risk threshold; and,

automatically modifying at least one of the specified ones of received quotes if said threshold is exceeded.

9. The method of claim **8** wherein the step of determining a risk level comprises calculating a delta value for the generated trade.

10. The method of claim **8** wherein the step of determining a risk level comprises calculating a trading volume for the generated trade.

11. The method of claim **8** wherein the step of determining an aggregate risk level comprises determining a net delta.

12. The method of claim **8** wherein the trading parameters further comprise a time duration, and wherein the step of determining an aggregate risk level comprises summing the deltas from trades involving at least a subset of quotes contained in said quote group that were executed within the time duration.

13. The method of claim **8** wherein the trading parameters further comprise an integer N, and wherein the step of determining an aggregate risk level comprises summing the deltas from the most recent N trades involving at least a subset of quotes contained in said quote group.

14. The method of claim **8** wherein the step of determining an aggregate risk level comprises determining a net contract volume.

15. The method of claim **8** wherein the step of determining an aggregate risk level comprises determining a weighted sum of contract volumes.

16. The method of claim **8** wherein the step of determining an aggregate risk level comprises determining an aggregate volume quantity.

17. The method of claim 8 wherein the step of automatically modifying at least one of the specified ones of said received quotes comprises canceling all said specified ones of said received quotes.

18. The method of claim 8 wherein the step of automatically modifying at least one of the specified ones of said received quotes comprises reducing the quantity associated with the specified ones of received quotes.

19. The method of claim 8 wherein the step of automatically modifying at least one of the specified ones of said quotes comprises revising at least one of the bid and offer values of each of the specified ones of received quotes.

20. The method of claim 8 wherein the trading parameters comprise a positive risk threshold and a negative risk threshold.

21. The method of claim 20 wherein the step of comparing the aggregate risk level with the risk threshold comprises comparing the aggregate risk level to the positive risk threshold if the aggregate risk level is positive, and comparing the aggregate risk level to the negative risk threshold if the aggregate risk level is negative.

22. The method of claim 8 wherein the step of comparing the aggregate risk level with the risk threshold comprises comparing the absolute value of the aggregate risk level to the risk threshold.

23. The method of claim 8 wherein each of the specified ones of received quotes are associated with one of a first subgroup and second subgroup, and wherein the step of automatically modifying at least one of the specified ones of received quotes in the quote group comprises reducing the offer values of the quotes in the first subgroup and raising the bid values of the quotes in the second subgroup.

24. The method of claim 23 wherein the first subgroup comprises quotes on call series options and the second subgroup comprises quotes on put series options, and wherein the aggregate risk is positive.

25. The method of claim 23 wherein the first subgroup comprises quotes on put series options and the second subgroup comprises quotes on call series options, and wherein the aggregate risk is negative.

26. The method of claim 23 where the amount of said reducing and raising is determined in response to a modification increment parameter.

27. The method of claim 8 further comprising the step of automatically modifying a quote comprises regenerating a quote having associated trading parameters that has been filled as a result of the generated trade.

28. The method of claim 27 wherein the step of regenerating a quote is performed utilizing a regeneration increment.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,356,498 B2
APPLICATION NO. : 09/475534
DATED : April 8, 2008
INVENTOR(S) : Ross G. Kaminsky et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

On page 2, in column 1, line 8, under "U.S. PATENT DOCUMENTS", delete "5,744,877 A 4/1998" and substitute --5,774,877 A 6/1998-- in its place.

Signed and Sealed this

Second Day of December, 2008

JON W. DUDAS
Director of the United States Patent and Trademark Office

ADDENDUM 5

U.S. Patent No. 7,980,457,
Case CBM2013-00050 (PTAB) (Exhibit 1001)

A107 – A124

2015-1728, -1729 & -1730

Chicago Board Options Exchange, Incorporated
v.
International Securities Exchange, LLC

US007980457B2

(12) **United States Patent**
Kaminsky et al.

(10) **Patent No.: US 7,980,457 B2**
(45) **Date of Patent: Jul. 19, 2011**

(54) **AUTOMATED TRADING EXCHANGE SYSTEM HAVING INTEGRATED QUOTE RISK MONITORING AND INTEGRATED QUOTE MODIFICATION SERVICES**

(75) Inventors: **Ross G. Kaminsky**, Chicago, IL (US); **Richard A. Angell**, Evanston, IL (US); **Gordon D. Evora**, Chicago, IL (US)

(73) Assignee: **Chicago Board Options Exchange, Incorporated**, Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 427 days.

(21) Appl. No.: **12/035,996**

(22) Filed: **Feb. 22, 2008**

(65) **Prior Publication Data**

US 2008/0208734 A1 Aug. 28, 2008

Related U.S. Application Data

(63) Continuation of application No. 09/475,534, filed on Dec. 30, 1999, now Pat. No. 7,356,498.

(51) **Int. Cl.**
G06F 17/00 (2006.01)
G06Q 40/00 (2006.01)

(52) **U.S. Cl.** ..... **235/375**; 705/36 R; 705/38

(58) **Field of Classification Search** ..... 235/375, 235/376, 380, 385; 705/35, 36 R, 37, 38, 705/39, 40, 41

See application file for complete search history.

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Primary Examiner — Andrew Joseph Rudy
(74) *Attorney, Agent, or Firm* — Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

An automated trading exchange having integrated quote risk monitoring and quote modification services. An apparatus is implemented using at least one computer, having memory, and a processor. The computer is configured to receive orders and quotes, wherein specified ones of the quotes are contained in a quote group, and have associated trading parameters such as a risk threshold. Not all received quotes are required to have trading parameters as described herein. Preferably, the quote group contains all the quotes, or a subset of quotes, belonging to an individual market-maker for a given class of options contracts, or possibly the quotes of two or more market-makers that have identified themselves as belonging to a group for the purposes of risk monitoring and quote modification. The computer typically generates a trade by matching the received orders and quotes to previously received orders and quotes, and otherwise stores each of the received orders and quotes if a trade is not generated. The computer then determines whether a quote within the quote group has been filled as a result of the generated trade, and if so, determines a risk level and an aggregate risk level associated with said trade. The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically modifies at least one of the remaining quotes in the quote group. The computer may also automatically regenerate quotes that have been filled.

7 Claims, 7 Drawing Sheets

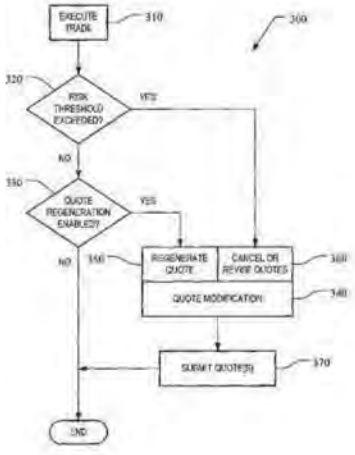

EXHIBIT
ISE 1001

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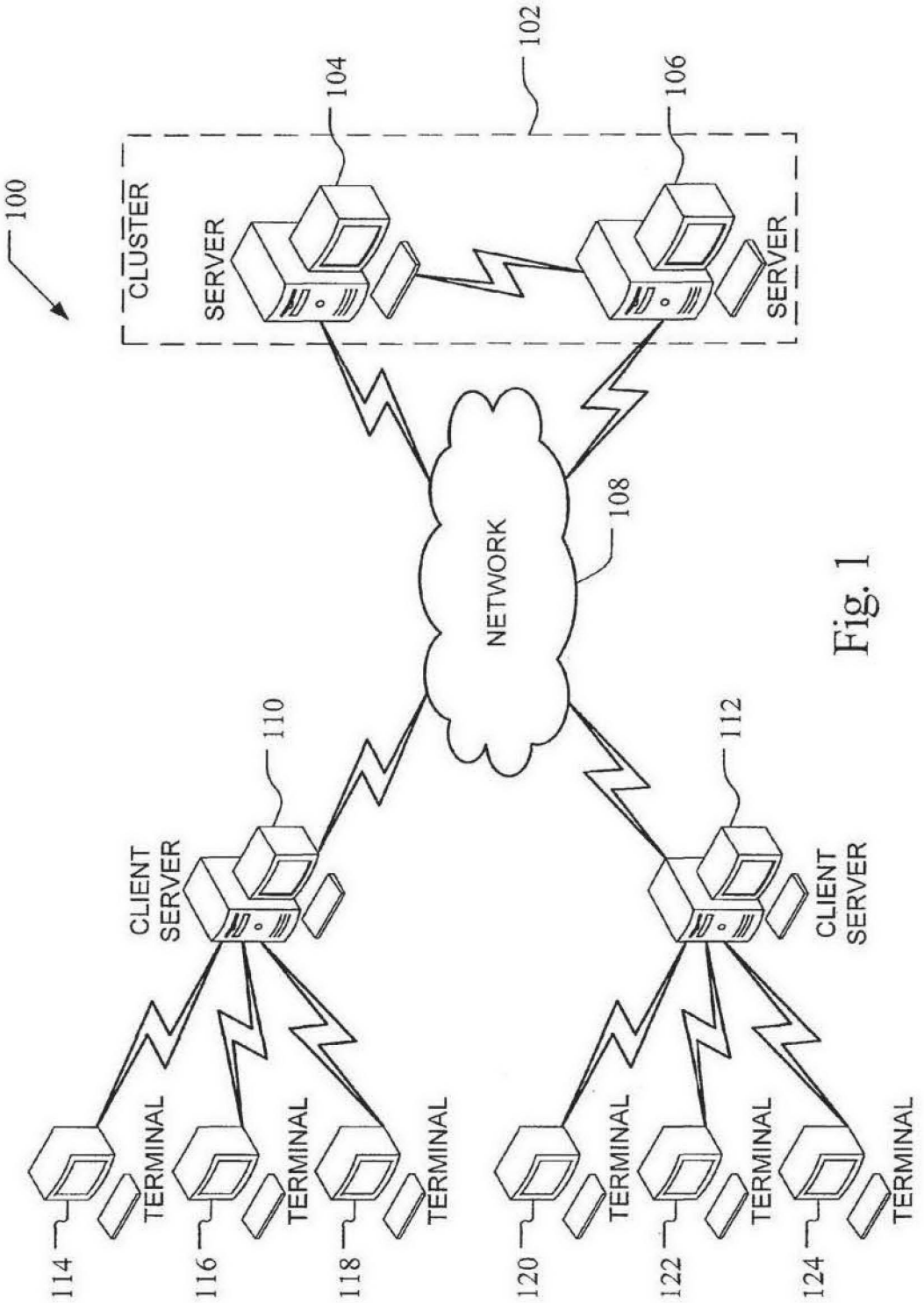

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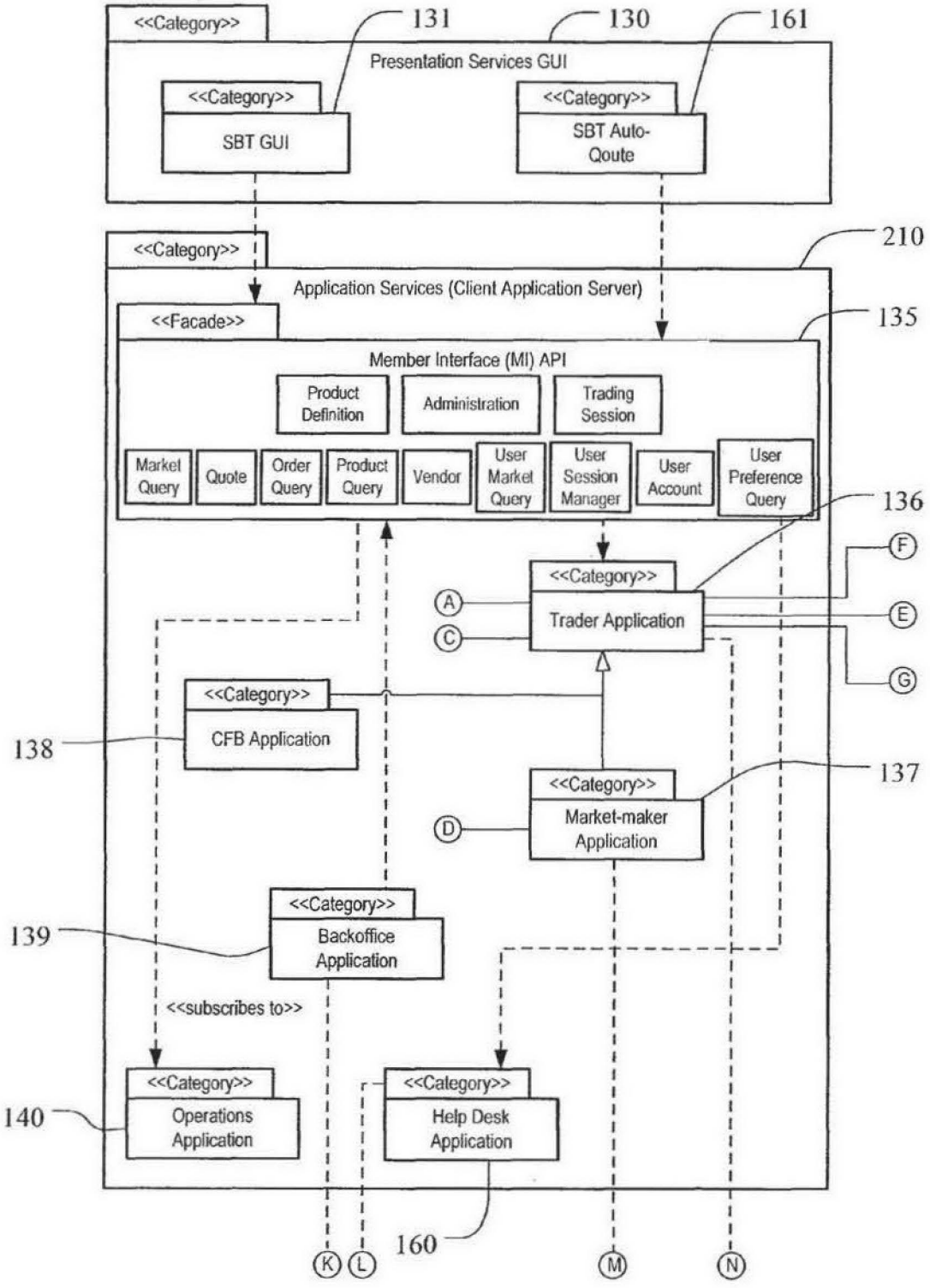
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Fig. 2A

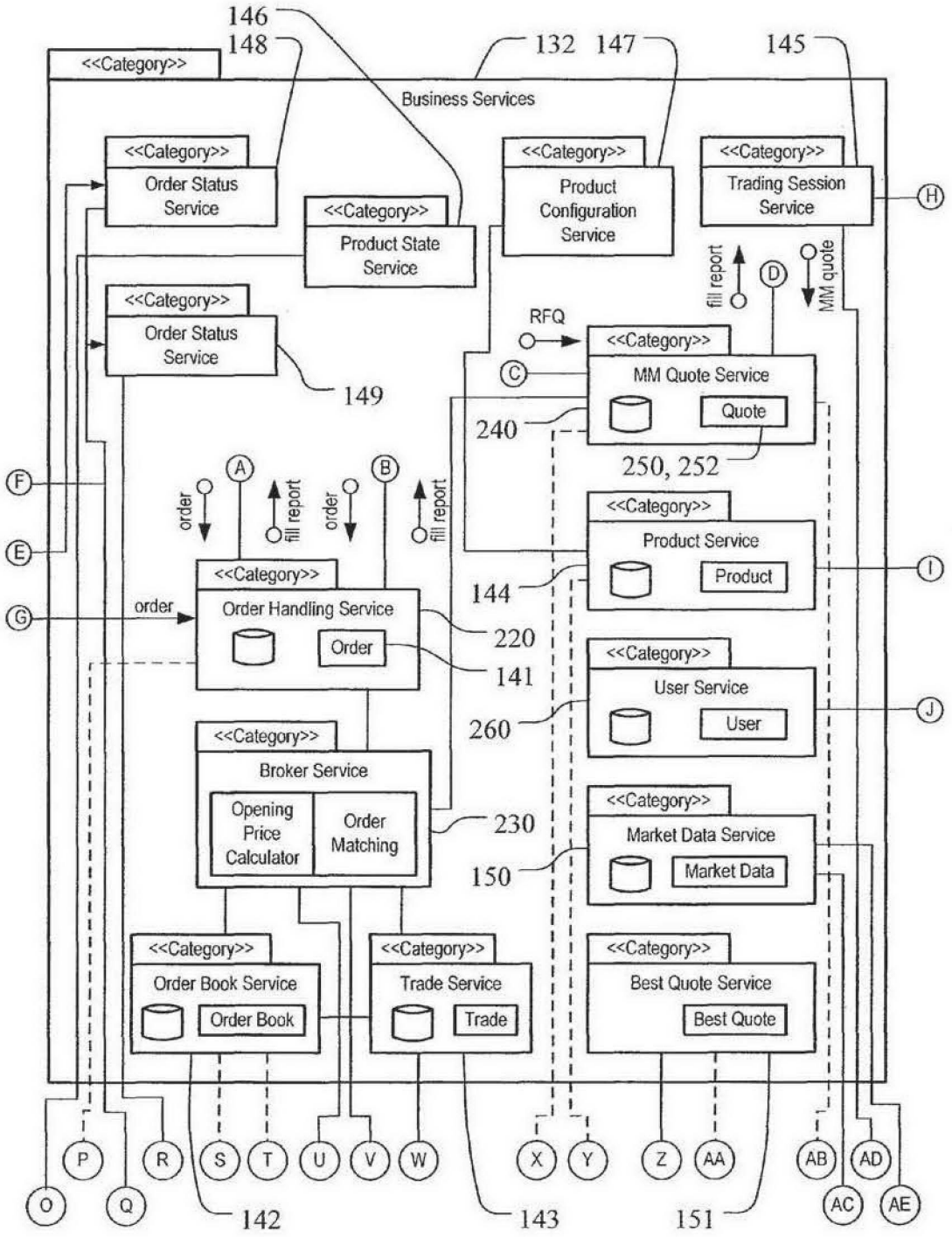
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Fig. 2B

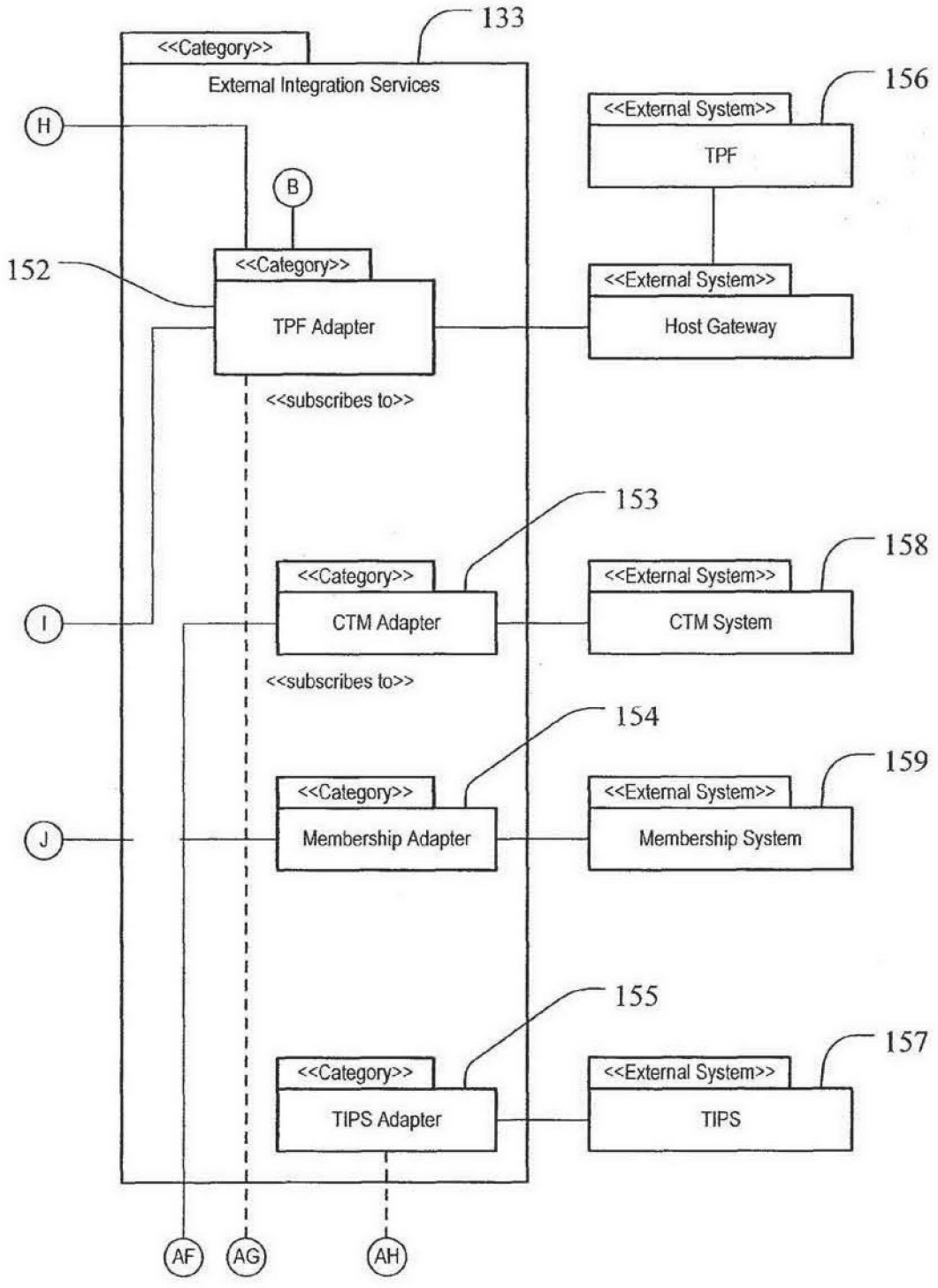
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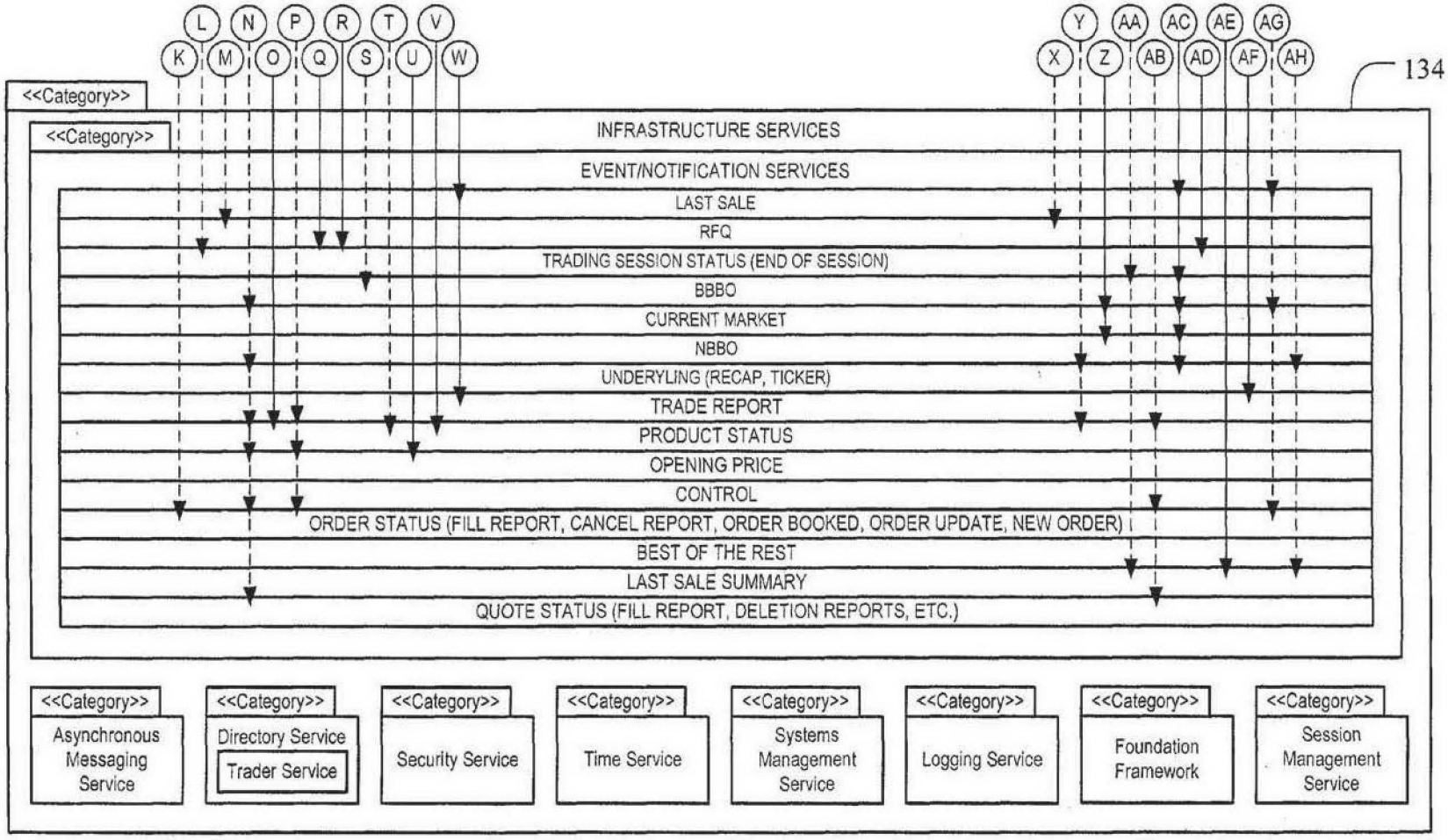
Fig. 2C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NBBO
UNDERYLING (RECAP, TICKER)
TRADE REPORT
PRODUCT STATUS
OPENING PRICE
CONTROL
ORDER STATUS (FILL REPORT, CANCEL REPORT, ORDER BOOKED, ORDER UPDATE, NEW ORDER)
BEST OF THE REST
LAST SALE SUMMARY
QUOTE STATUS (FILL REPORT, DELETION REPORTS, ETC.)
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Security Service
Time Service
Systems Management Service
Logging Service
Foundation Framework
Session Management Service

Fig. 2D

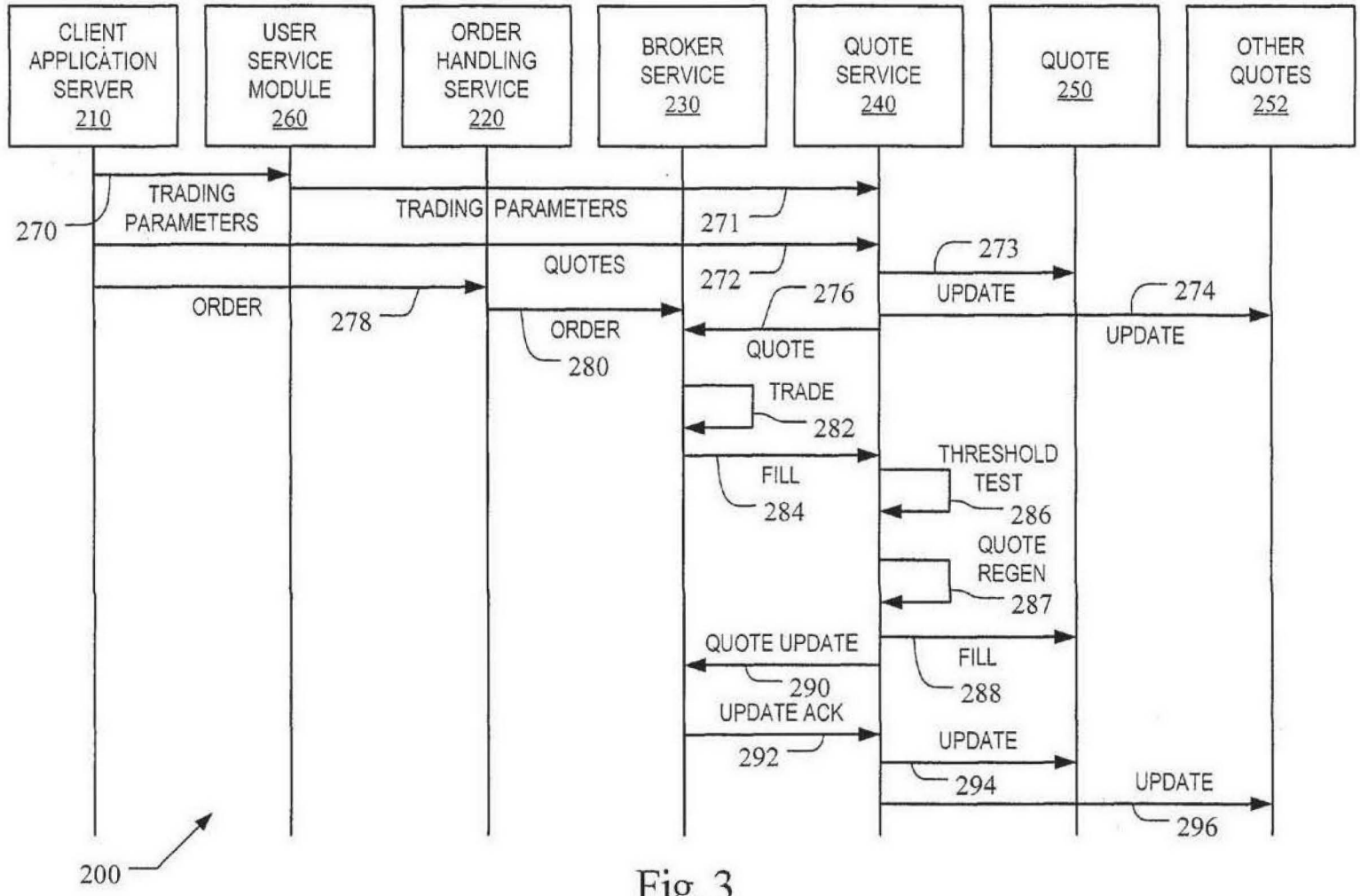
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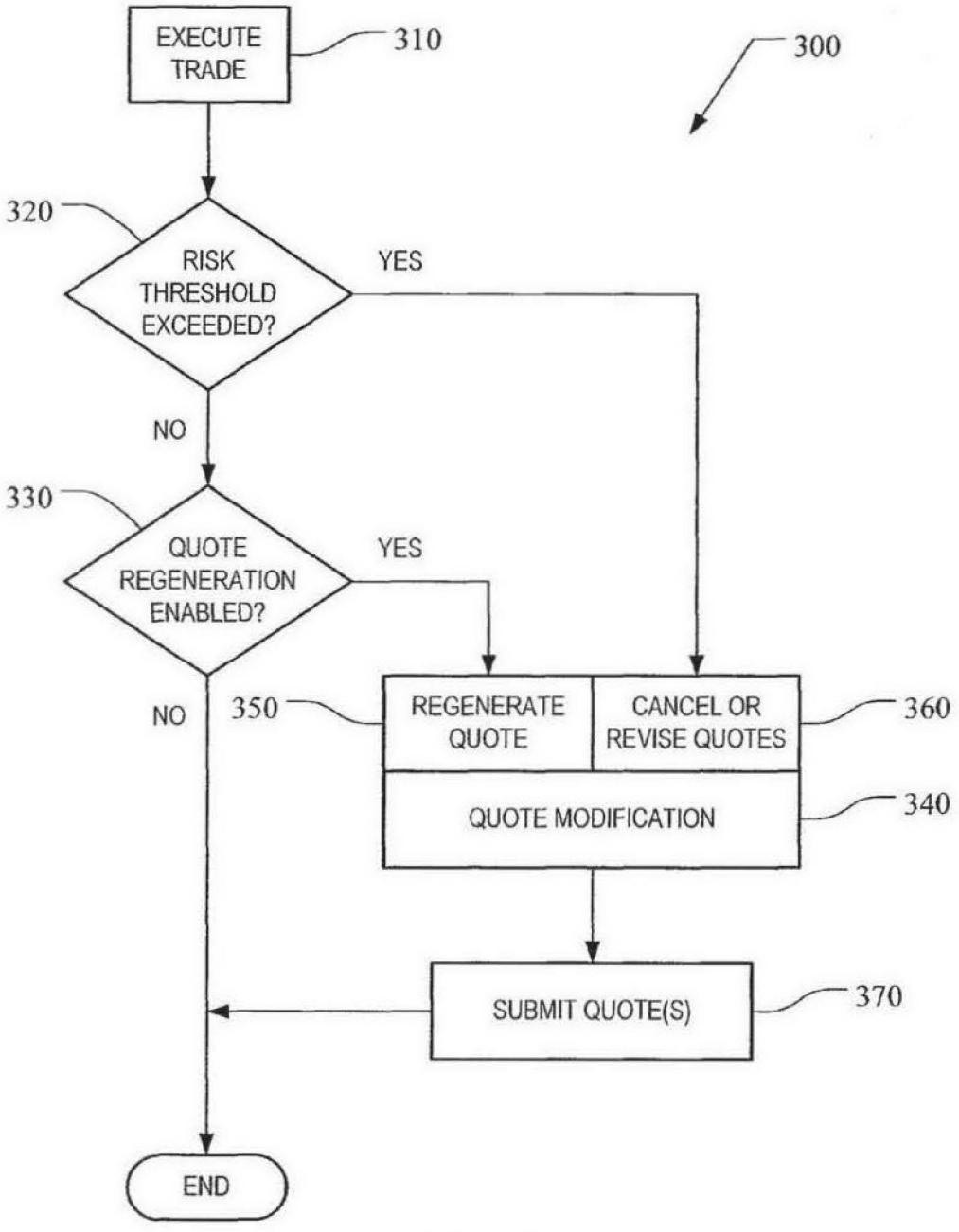
Fig. 3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REGENERATE QUOTE
CANCEL OR REVISE QUOTES
360
QUOTE MODIFICATION
340
SUBMIT QUOTE(S)
370
END

Fig. 4

AUTOMATED TRADING EXCHANGE SYSTEM HAVING INTEGRATED QUOTE RISK MONITORING AND INTEGRATED QUOTE MODIFICATION SERVICES

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. application Ser. No. 09/475,534, filed Dec. 30, 1999, now U.S. Pat. No. 7,356,498, the entirety of which is incorporated herein by reference.

A. FIELD OF THE INVENTION

The present invention relates to financial trading systems. More specifically, it is directed to a method and device for market-maker risk management through automatic quote risk monitoring and quote modification in an automated trading system.

B. DESCRIPTION OF THE RELATED ART

1. Option Trading

Option contracts are traded publicly on many exchanges throughout the world. These securities, referred to generally as "options," convey certain rights to buy or sell an underlying stock, commodity, or other security at a fixed price for a specific period of time—until expiration for an American-style option or at expiration for a European-style option. All option contracts that trade on U.S. securities exchanges are issued, guaranteed and cleared by the Options Clearing Corporation (OCC). OCC is a registered clearing corporation with the SEC.

The potential loss to the buyer of an option can be no greater than the initial premium paid for the contract, regardless of the performance of the underlying stock. This allows an investor to control the amount of risk assumed. On the contrary, the seller of the option, in return for the premium received from the buyer, assumes the risk of being assigned the obligation to buy or sell the underlying security if the contract is exercised. Therefore, writing options can lead to large potential exposure.

Further background information may be obtained from the book "OPTIONS, Special Concepts and Trading Strategies," The Options Institute, The Educational Division of the Chicago Board Options Exchange, Second Edition, McGraw Hill (1995), the contents of which are incorporated herein by reference.

2. Open Outcry Trading and Automated Exchanges

Many trading systems utilize what is known as an open outcry method of trading. In the open outcry system, market-makers are required to make a two-sided market by providing a bid and offer quote in all option series. The market-makers typically communicate verbally or visually with contra traders indicating their willingness to buy and sell various quantities of securities. Because the market-makers have personal control over the types and number of contracts traded, they can adjust their trading strategies as their positions change. In this way, the market-makers can manage their exposure, or risk, associated with their holdings by adjusting their quotes to favor trades that would tend to hedge away unwanted exposure.

In an automated trading environment, a certain amount of control is lost when a market-maker has issued quotes in a large number of option series. The quotes are typically recorded in the automated and computer-based trading system, and matched up automatically with orders that enter the system electronically. With the proliferation of computer trading systems and increased communication speeds, the rate at which trades may be executed by an automated system far surpass the rate of trades that occur in an open outcry system. The speeds are such that the rapidity of trades may exceed the market-maker's ability to adapt his or her position. Specifically, one disadvantage of automated trading systems is that a number Of automatic trades may occur within a very short time that result in an unacceptable risk being assumed by a market-maker. That is, the trades may occur so rapidly that the market-maker is unable to withdraw or modify his quotes in a timely manner.

There exist software tools that can analyze stock and option portfolios in close to real time. Market data is provided to the software analysis tools and used to evaluate the risk associated with stock and option portfolios. In addition, the tools may provide recommendations for trades and quotes and automated submission of those trades and quotes. However, even if a market-maker utilizes such a computer-implemented automated position analysis tool to revise or cancel quotes, the software tools may be unable to act in time given the speed at which an automated trading exchange system is capable of executing incoming orders. In particular, one aspect of existing exchange systems is that transactions are received and processed in the order received. Thus, even if a market-maker responds immediately using an automated software tool, the exchange may have a message queue containing additional orders that will be processed before the exchange system receives and processes the market-maker's quote cancellation request.

The result is that a market-maker who is willing to take on a predetermined level of risk must limit the number of quotes or the depth (quantity) of each quote to ensure that rapid trades do not result in an unacceptable aggregate risk, rather than issuing quotes having greater depth and breadth (where the filling of a single quote might reach the market-maker's risk limit). Thus, a market-maker's limited control over risk management may have the undesirable effect of hindering the liquidity of the market.

It would therefore be desirable to have a trading exchange system and method for automatically canceling, regenerating, or modifying quotes under certain trading conditions.

SUMMARY OF THE INVENTION

A method and apparatus for an automated trading exchange having integrated quote risk monitoring and quote modification services is provided. In accordance with a first aspect of the invention, an apparatus is implemented using at least one computer, having memory, a processor, and a communication port. The computer is configured to receive orders and quotes, wherein specified ones of the quotes are contained in a quote group, and have associated trading parameters such as a risk threshold. Note that not all received quotes are required to have trading parameters as described herein. Preferably, the quote group contains all the quotes belonging to an individual market-maker for a given class of options contracts, or possibly the quotes of two or more market-makers that have identified themselves as belonging to a group for the purposes of risk monitoring and quote modification. The computer typically generates a trade by matching the received orders and quotes to previously received orders and quotes, and otherwise stores each of the received orders and quotes if a trade is not generated. The computer then determines whether a quote within the quote group has been filled as a result of the generated trade, and if so, determines a risk level and an aggregate risk level associated with said

trade. The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically modifies at least one of the remaining quotes in the quote group. The computer may also automatically regenerate quotes, that is, automatically issue new quotes when trades have occurred against previous quotes.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features and advantages of the present invention will be more readily appreciated upon reference to the following disclosure when considered in conjunction with the accompanying drawings, in which:

FIG. **1** depicts a preferred embodiment of the quote modification trading system;

FIGS. **2**A, **2**B, **2**C, and **2**D show the interconnection of various software modules associated with the quote risk monitoring and modification trading system;

FIG. **3** shows a sequence diagram of a preferred embodiment of the quote modification system; and

FIG. **4** shows a flowchart depicting the method of modifying quotes.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT(S)

With reference to FIG. **1**, a preferred embodiment of the system **100** utilized for trading and quote modification is described. The system **100** (also referred to herein as a screen-based trading system, or SBT system) includes a plurality of computers, which may be one or more workstations, servers, mainframes, or other computer hardware platforms that provide sufficient resources to meet the desired trading volume and desired transaction-processing rate. In the preferred embodiment shown in FIG. **1**, the system includes a number of computer clusters such as cluster **102** (although only one is depicted in FIG. **1**), where each cluster **102** handles trading for a number of securities, such as one or more classes of options. In the preferred embodiment, each cluster **102** is made up of two servers **104**, **106**. The servers **104**, **106** are preferably multiprocessor SUN **4500** servers available from SUN Microsystems of Palo Alto, Calif. SUN Enterprise™ servers or Starfire™ servers are a preferable alternative.

The servers **104** and **106** in cluster **102** communicate with a plurality of client servers **110**, **112** that are typically located at remote locations, such as at a brokerage house, but may also be located in the same facility as the clusters **102**. Network **108** facilitates communication between the clusters **102** and the client servers **110**, **112**. The network **108** is preferably a private LAN/WAN configuration, but a public network may be utilized, provided sufficient redundancies and message security are provided. Two such client servers **110**, **112** are shown in FIG. **1**. Each client server **110**, **112** may be provided with a predetermined message throughput rate into network **108**, where the throughput rate may be a maximum rate determined by various parameters, including the volume of orders sent by the client server **110**, **112**, the volume of quotes sent by the client server **110**, **112**, the number of option series for which quotes are provided, communication/connection fees paid by the brokerage house or other entity utilizing the client server **110**, **112**, the overall capacity of the trading system **100**, etc. The client servers **110**, **112** preferably communicate with other elements of the automated exchange system using a client application server module **210**, as further described below, running on client servers **110**, **112**.

Each client server **110**, **112** is capable of serving a number of clients, shown as terminals **114**, **116**, **118**, **120**, **122**, and **124** in FIG. **1**. The client terminals **114-124** may be "dumb" terminals, stand alone computing devices (PCs or workstations), or even portable wireless terminals. The client servers **110**, **112** may communicate with the client terminals **114-124** using a proprietary protocol or one of many standard public domain protocols. The client servers **110**, **112** may include a web server or connect to a separate web server for processing tcp/ip, http, html, java, and the like, and provide access to client terminals **114-124** over the Internet in addition to (or as an alternative to) private LAN/WAN or Virtual Private Network access. For embodiments that include a webserver, the web server preferably utilizes common gateway interface scripts (cgi) to interface with the client application server **210**. In addition to cgi scripts, or as an alternative to cgi, other web server interfaces and server extensions may be utilized to provide communication between the web server and the application server **210**. The client servers **110**, **112** communicate with the users of terminals **114-124** by way of secure Internet communication protocols or by private LAN/WAN or VPN communication links. Thus the client terminals **114-124** may run dedicated proprietary software to communicate with the client server **110**, **112**, or may interface with client servers **110**, **112** via a standard web browser. The web browser may operate using built-in java scripts, or may also include specialized browser modules that are provided to the client terminals.

The automated exchange system **100** is comprised of the following five logical software modules: Presentation Services Graphical User Interface (GUI) **130** (FIG. **2**A); Application Services **210** (Client Application Server, Gateway) (FIG. **2**A); Business Services **132** (FIG. **2**B); External Integration Services **133** (FIG. **2**C); and, Infrastructure Services **134** (FIG. **2**D).

With reference to FIG. **2**A, the Presentation Services GUI module **130** is constituted by applications that interact with the exchange system **100** via the Member Interface (MI) API **135**. There are two types of client applications, those that provide a GUI to allow user interaction with the system directly and applications that automate trading functions.

An SBT (screen-based trading) GUI module **131** is responsible for displaying the contents of a particular model to the screen and updating the display if the model's contents change. This module **131** contains several GUI applications, one for each of the major classes of human actors that use the system **100**: traders, market-makers, clearing firm brokers, and system operators. The Trader GUI is used by regular traders. It consists of several GUI's for displaying and entering orders, and market data. The Market-Maker GUI is an extension of the Trader GUI and is used by market-makers. It consists of several GUI's for displaying and entering orders, quotes, and market data. The Clearing Firm Broker GUI is an extension of the Trader GUI and used by clearing firm brokers. It consists of several GUI's for forcing the logout of a market-maker and for setting a maximum order quantity for the quotes and orders of the clearing firm's market-makers. The system operation GUI is used by system operators and help desk operators. The autoquote system **161** runs on the market-maker's work station and is used by the market-maker to generate quotes for various option series.

The Application Services module **210** contains subordinate modules that forward requests initiated by human or automated actors, to be executed by the appropriate Business Services module(s) **132**. These applications submit requests to Business Services components **132**, notify clients of business events, and maintain user-specific views of information

in the Business Services **132**. This module also encompasses a Member Interface (MI) API **135** that provides a single entry point to the system exposing the applications in the Application Services Module **210** (i.e., Trader, Market-Maker). In addition, the Application Services Module **210** maintains instantaneously updated views that reflect the prevailing state of each actor's information in the Business Services module **132**.

The Trader Application module **136** has the following specific responsibilities: submit, cancel, update, and cancel/replace orders; submit requests for quotes; present the current status of the trader's orders; present fill and cancel reports; present Market Best Bids and Offers for selected products; set the trader's defaults and preferences; present Book Depths for selected products; and, present underlying quotes/last sales and news alerts.

The Market-Maker module **137** inherits the Trader App module's **136** responsibilities and adds the following: submit and modify market-maker quotes; present requests for quotes; set the market-maker's defaults and parameters; set autoquote parameters; submit autoquotes.

The Clearing Firm Broker module **138** inherits the Trader App module's **136** responsibilities and adds the following: assume control of a trader's privileges. A Clearing Firm Broker can force the logout of a market-maker; set a maximum order quantity for quotes and orders of the clearing firm's market-makers.

The BackOffice application **139** is responsible for reporting order status information. This can include fill reports, cancel reports and new order notifications. The Operations application **140** has the following responsibilities: start and shutdown the SBT system; start and stop trading of a product; change the status of a product's market (pre-open, open, close, halt, etc.); present logged system events; maintain SBT-specific trader information; maintain SBT-specific product information; maintain trading parameters (quote width, minimum market-maker order default size, required percent of responses to a request for quote (RFQ), maximum response time to an RFQ; etc).

The functionality of the Trader **136**, Market-Maker **137**, Clearing Firm Broker **138**, and Back Office **139** modules is exposed by a facade, the Member Interface (MI) Application Programming Interface (API) **135**. The Member Interface **135** exposes different subsets of functionality depending on the user that logged on to the system. The intention behind sharing a common API among the different trader classes is to allow workstations to service all of them. Separate API's may alternatively be used for the different user classes.

The Member Interface API **135** supports both SBT client applications and external applications owned by members. Members use the Member Interface API to link their existing computer systems to the exchange system **100**, to submit orders electronically and to automate trading. Likewise, market-makers use the API to submit autoquotes employing their proprietary systems, instead of the default autoquote application **161** provided by SBT.

The following system functions are preferably accessible through the API: session logon and logoff; market state inquiry and change notification; connection status inquiry and change notification; order entry, cancellation, and replacement; quote entry, cancellation, and replacement; RFQ notification; order status inquiry and fill notification; subscription to product markets; best market quotes notification; book "depth" inquire and change notification.

Referring now to FIG. **2**B, the Business Services module **132** contains the core functionality of the automated exchange system **100**. It includes components that correspond to the key business object model entities of the automated trading system such as members, orders, books, products, quotes, et cetera. In addition, it includes components to administer and operate the system **100**.

The Order Handling Service module **220** maintains the current state of all orders persistently. Specific operations may be exposed directly by Order objects **141**, bypassing the Order Handling Service **220**. Logically, Orders are components of this module. Specifically, the Order Handing Service **220** and Order components are responsible for: receiving and storing incoming orders (from SBT clients or TPF **156**(FIG. **2**C)); forwarding incoming orders to the Broker module for execution; receiving order state change notifications from the Broker and Order Book modules and updating stored orders with this information (the functionality is provided by exposing Orders, allowing the Broker and Order Book components to directly update the orders); sending fill reports to originating traders upon receiving fill notifications from the Broker and Order Book modules; receiving order cancellation requests and forwarding them to the Broker and Order Book modules (upon confirmation of a cancellation, notifying the originating trader of the result of the request and updating the stored state of the order); and receiving order cancellation/replacement requests and forwarding them to the Broker and Order Book modules (upon confirmation of the cancellation/replacement, notifying the originating trader of the result of the request and updating the stored state of the order).

The Broker Service module **230** is responsible for executing the following types of orders: limit, market, all or none, fill or kill, immediate or cancel, stop, stop limit, and spread. Upon trade execution, the Broker Service **230** is responsible for notifying the Trade Service module **143** of all the orders matched (all parties to the trade) in the trade. It is also responsible for notifying the Order Handling Service (i.e. Orders) **220** and Market-Maker Quote Service (i.e. Quotes) **240** of the fills.

The responsibilities of the Order Book Service module **142** are: cooperate with the Broker Service **230** in calculating the opening price during a product's pre-opening period; acknowledge that an order was accepted by publishing an event consumed by the Trader application **136** which originated the order; cancel and cancel/replace resting orders; upon changes to the top of the book, publish the new Book Best Bid Offer (BBBO) and last sale.

The responsibilities of the Trade Service module **143** are: receive trade notifications from the Broker Service **230**; format trade reports; store trade reports; and forward trade reports to trade match (via TPF **156**).

The Market-Maker (MM) Quote Service module **240** is responsible for: receiving requests for quotes (RFQs) from traders; submitting RFQs to market-makers assigned to the product for which the quote was requested (by publishing in the RFQ event channel); receiving and logging market-maker responses to RFQs (market-maker quotes); upon receiving a market-maker quote, saving it persistently and submitting them to the Broker Service module **230** for execution; sending fill reports to originating market-makers upon receiving fill notifications from the Broker and Order Book modules; canceling or updating a Market-Maker quote upon receiving a request from the originating market-maker by submitting the request to the Broker/Order Book; canceling or updating or regenerating Market-Maker quotes upon receiving a fill report; upon inquiry, providing the history of the quotes submitted by a market-maker.

The Product Service module **144** maintains all product-related information. In order to perform its responsibilities, the Product Service module **144** downloads, and preferably caches, product information from TPF **156** and TIPS **157**. The User Service module **260** maintains all user-related information, both specific to SBT and contained in the Membership System. It provides a unified interface to SBT components accessing user information, hiding the actual location of the maintained data, thus simplifying client logic.

The User Service module **260** maintains the information of traders, market-makers, clearing firm brokers, operators, help desk personnel, back-office personnel. In one embodiment, the data is cached for performance reasons and the data is synchronized from the TPF **156** source.

The Trading Session Service module **145** maintains all business day and trading session-related information and manages the different states of a trading session, e.g. open, closed, and halted. Products that are processed/traded in each trading session are also kept at this service. In order to perform these responsibilities, the Product Service module **144** downloads trading session and product information from TPF **156**, as well as monitor events that affect products traded within a session.

The Product State Service **146** is responsible for coordinating product state changes for all products, e.g. pre-opening, opening, trading; halting, closing, and post-closing. It works closely with the Broker Service **230** to insure that state changes occur in a timely fashion. The service **146** monitors events that affect products traded, such as monitoring the underlying market to detect when the primary exchange opens, closes or halts trading a product. The Product Configuration Service **147** is responsible for providing the location of where a product is processed/traded. This information is primarily used to route product-specific requests (e.g. orders) for processing. The Order Status Service **148** provides subscription and notification services related to orders (i.e., fill reports, cancel reports, order accepted by book, etc.).

The Quote Status Service module **149** provides subscription and notification services related to quotes (i.e. fill reports, deletion reports, etc.) The service **149** preferably replaces the use of event channels for quote status reporting, providing a more secure mechanism for status delivery. The Market Data Service **150** maintains a current snapshot of market data, in addition to publishing market summary data. The module also provides an interface to clients to query historical market data.

The Best Quote module **151** is responsible for calculating the market best (aggregate quantities of buy and sell orders at the best price) for each product and sending them to TPF **156** (which in turn forwards them to the Options Price Reporting Authority) for public dissemination. In addition, it is responsible for calculating and disseminating the National Best Bid Offer (NBBO). In order to provide this information, the Best Quote module **151** subscribes to the event channel referred to herein as the Best of the Rest channel to obtain the current best quote from competing exchanges. The Best Quote module **151** then determines the source of the NBBO, whether it is from the present exchange or a competitor, and publishes the results to the Best Quote event channel, of which the TPF Adapter **152** is a subscriber.

Referring now to FIG. **2**C, the External Integration Services module **133** includes adapters **152**, **153**, **154**, and **155**, that map the interaction paradigms of external systems to the ones in the system **100** architecture. The adapter modules "adapt" (or "wrap") the native legacy interfaces to interfaces appropriate in the SBT environment. The TPF (Transaction Processing Facility) module **152** contains the adapter to allow SBT and TPF **156** to interact. TPF data is received, remoduled, and broadcast/delivered to the appropriate components within SBT. Conversely, SBT data is received, either through direct invocation or event consumption, remoduled, and sent to TPF **156** using its native interface.

The Membership Adapter **154** translates requests for member information received from SBT components into requests to the Membership System **159** and returns the results after reformatting.

The TIPS Adapter **155** subscribes to TIPS **157** to receive the external market data needed in the SBT environment, including underlying market data and the Best of the Rest of options listed in SBT. The Events Service (FIG. **2**D) notifies the TIPS Adapter **155** of consumer subscriptions so that it can propagate these subscriptions back to TIPS **157**. Once subscribed, the TIPS Adapter **155** reformats the market data received from TIPS **157** and publishes it for consumption by SBT components. Another responsibility of this adapter **155** is to publish underlying product state events when external markets change their states, for instance when they open, halt, close, etc.

The Trade Match Adapter **153** receives SBT data and forwards it to TM **158**. The TM Adapter **153** handles the following data flows: Trade Report (SBT to TM)—SBT reports all the parties to a trade to TM **158**.

Referring now to FIG. **2**D, the Infrastructure Services module **134** contains commercial "off-the-shelf" software and extended infrastructure services that provide enterprise-wide support to various other external systems. One mechanism by which the SBT system components interact with each other is by supplying and consuming events, implemented as a publish/subscribe pattern. The following list provides a brief description of the event flows/notification services (messaging services) shown in FIG. **2**D.

- RFQ—the Market-maker (MM) Quote Service supplies RFQ events consumed by the Market-Maker Application.
- BBBO—the Order Book supplies Book Best Bid Offer (BBBO) events consumed by the Best Quote Service.
- NBBO—the Best Quote Service supplies National Best Bid Offer (NBBO) events consumed by the Trader Application, and Market Data Service.
- Current Market—the Best Quote Service supplies Current Market Best events, containing a product's best quote, consumed by the Market Data Service and Trader Application. The best quote indicates if the exchange has the best quote.
- Best of the Rest—the TIPS Adapter component supplies best-of-the-rest events consumed by the Best Quote Service.
- Last Sale—the Trade Service supplies last sale events consumed by the Market Data Service **150** and TPF Adapter **152**.
- Last Sale Summary—the Market Data Service **150** component supplies last sale summary events consumed by the Trader application;
- Logging—the Logging Service Proxy component supplies Log Service events consumed by the Log Service component.
- System Management—the Foundation Framework supplies System Management events consumed by the System Management component.
- Instrumentation—the Instrumentation Service component supplies Instrumentation events consumed by both the System Management component and the Log Service component.

Underlying Ticker—the TIPS Adapter supplies Underlying ticker events (prices, quotes, last sales, news alerts) consumed by the Trader Application and the Product Service.

Underlying Recap—the TIPS Adapter supplies Underlying summary events (high and low prices, volume) consumed by the Market Data Service and Trader Application.

Trade Report—the Trade Service supplies Trade Report events consumed by the TPF Adapter **152**.

Product Status—the Product Service **144** and Product State Service **146** supply Product Status events (State, Price Adjustment, and Update) events consumed by the Trader application, Order Handling Service **220**, and TPF Adapter **152**.

Trading Session Status—the Trading Session Service **145** supplies Trading Session State events consumed by the Operations Application **140** and Help Desk application **160**.

End of Session Summary—the Trading Session Service supplies End of Trading Session Status events.

Opening Price—The Broker Service module **230** supplies Opening Price events consumed by the Trader Application **136**.

Control—the Operations **140** and Help Desk **160** applications supply Control events, possibly through the System Management component, consumed by Business Services **132** and External Integration Services **133** components.

Order Status—the Order Handling Service **220** (Order) supplies Fill Report, Cancel Report, Updated Order, New Order, and Order Accepted by Book events consumed by the Order Status Service **148**, and TPF Adapter **152**.

Quote Status—the MM Quote Service **240** (Quote) supply Fill Report, and Delete Report events consumed by the Quote Status Service **149**.

In accordance with a preferred embodiment, there are four major tiers of the application software. The business services **132** handle all the SBT order matching, execution and reporting functionality. It provides the repository for all SBT information data. The application services **210** handle the application presentation and act as the application front end to the business services. Different views of the business services **132** and collaboration of business objects are grouped together and are presented to the user based on logon authentication and authorization level. The two tiers communicate to each other by two supported tiers: the infrastructure services **134** and external integration services **133**. The infrastructure services **134** provide a seamless integration between the application services **210** and business services **132**. The external integration services **133** provide the access to the external system.

With reference to FIG. **3**, a sequence diagram **200** for a preferred embodiment of the automated exchange system **100** is shown. The system **100** includes a client application server **210**, an order handling service module **220**, a broker service module **230**, a quote service module **240**, a user service module **260**, and quote objects **250** and **252**. The service modules **220**, **230**, **240**, **260** and objects **250**, **252** are preferably software modules running on clusters **102**, or on one or more interconnected computers. The software modules are preferably written in an object-oriented programming language and are compiled to run on the clustered computers **102**. Preferably, the software utilizes the C++ language, the Java programming language, or other object-oriented language. Alternatively, any suitable software language may be used to implement the system, as will be understood by one of ordinary skill in the art. The modules also interact with a database program used for storing data and other system and user information. In the preferred embodiment an Oracle database system is used.

The client application server **210**, as discussed above, runs on client servers **110**, **112**, and provides an interface to one or more clients. The client server **110**, **112** may include one or more application modules, depending upon the intended users of the servers **110**, **112**. For example, the client servers **110**, **112** preferably include at least one of a market-maker application, a trader application, a back-office application, or a member interface. The client servers **110**, **112** also preferably utilize a user authentication and role-based security model to control access to the various application modules.

The client server **110**, **112** may also include modules such as a help desk application, an operations application, and a Clearing Firm Broker (CFB) module. The CFB module may be configured to allow a Clearing Firm to set maximum volume limits on a per-class basis. The Help Desk module is preferably enabled for use on client servers that provide connectivity to exchange management personnel. The Help Desk provides a utility to force a user to logout of the system.

The order handling service **220** forwards orders to the appropriate broker service module **230** that handles the class of options to which the individual orders relate. If the broker service module **230** cannot execute the order immediately, it routes it to the order book service module, which maintains the current state of all pending orders and quotes. The order handling service module **220** receives order information from various sources, including brokers, traders, market-makers, etc. The orders may enter the system from a client application server **210** or through an alternative interface such as TFP adapter **152**, which is a connection that allows a pre-existing automated order handling system such as TPF system **156**, to access the present system.

The broker service module **230** is responsible for executing various types of orders, including limit, market, all or none, fill or kill, immediate or cancel, stop, stop limit, and spread orders. Preferably, there are numerous broker service modules **230** running on the exchange server **104**, or on the interconnected computers in the cluster **102**, where each broker service module **230** handles trades for a subset of products offered by the exchange. For example, there is preferably a broker service module **230** for each class of option contracts. The broker service module **230** thus matches incoming orders to other orders or to quotes supplied by market-makers to complete a trade, indicated by line **282** in FIG. **3**.

The broker service module **230** also receives quotes from the quote service **240**, discussed below. The broker service module **230** attempts to execute a trade **282** by matching incoming quotes to orders or to other quotes stored by the order book service module **142** in the order book. Note that for purposes of trade execution **282**, quotes are treated by the exchange system **100** as if they were orders. Thus, when the broker service module **230** receives a quote that it cannot match to an existing order or quote, it sends the quote to the order book for storage with other unfilled quotes and orders. Preferably, quotes differ from regular orders in that a quote may be two sided, having a bid and an offer price, and that each market-maker may only have one quote per product in the system.

To facilitate the order matching process of trade execution **282**, the broker service module **230** has direct access to orders stored in the order book by the order book service module **142**. Preferably, when the incoming order is matched to an

existing quote supplied by the quote service module **240**, the broker service module **230** provides the quote service module **240** with details of the trade.

The quote service module **240** manages the quotes supplied by market-makers via client application service module **210**. The quote service module **240** submits the quotes to the broker service module **230** for execution. The quote service module **240** ensures that each individual market-maker has only one quote per product in the system at any given time. When a market-maker enters a new quote on a product for which he already has an outstanding quote, the quote service module preferably determines whether there is already an existing quote in the system for that market-maker and, if so, informs the broker service module **230** that the pre-existing quote is to be cancelled. The quote service module **240** submits the new quote to the broker service module **230** only after it has received acknowledgement from the broker service module **230** that the pre-existing quote has been cancelled.

The broker service module **230** issues fill reports to notify various other modules, and ultimately the trading entities, that the trade was executed. Upon notification of a fill **284** from the broker service module **230** (or the order book module), the quote service module **240** informs the quote object **250**. In turn, the market-maker is notified of the fill via the exchange's reporting system. The quote service module **240** also cancels or updates a market-maker quote upon receiving a request from the originating market-maker by submitting the request to the broker service **230**. The quote service module performs this by first informing broker service module **230** that the pre-existing quote has been cancelled. The broker service module **230** then removes the quote from the order book and confirms to the quote service **240** that the quote has been cancelled. The quote service **240** then submits the new quote (if one exists) to the broker service module **230**.

With respect to FIG. **3**, a preferred sequence of events and messages will be described. Market-Makers log into a client application server module **210** and access the user service module **260**. The market-maker communicates with the user service module **260** through a terminal, such as a workstation or wireless handheld unit. As shown by line **270**, trading parameters, or quote parameters, are sent to the user service module **260**. Upon initialization of the quote service, or upon login of a new market-maker, various trading parameters are provided to the quote service module **240** as shown by line **271**. The trading parameters may include a risk threshold, a quote regeneration indicator, a quote regeneration increment, a quote modification indicator, and a quote modification increment. The parameters may include numerous sets of thresholds, indicators, and increments, preferably one such set for each class for which the market-maker is providing quotes.

The quote service module **240** receives quotes from market-makers as shown by line **272**, and provides these quotes to the quote objects **250**, **252**, as shown by update lines **273**, **274**, and to the broker service module **230** as shown by line **276**. As mentioned above, the quote service module **240** will not forward updated quotes (as opposed to new quotes) to the broker service module **230** before first canceling old quotes.

Orders received by the client application server **210** are routed to the order handling service **220** as shown by line **278**. The order is then forwarded to the appropriate broker service **230** as shown by line **280**. The broker service module **230** attempts to execute every order or quote received with the best order (or quote) in the book as shown by line **282**. When a trade is executed, a fill report is issued to the quote service module **240** as shown by line **284**. The quote service module **240** then analyzes the trade and determines whether the market-maker's risk threshold has been exceeded, as shown by line **286**. The threshold test will be described in further detail below. A fill report is sent to the quote object **250** as shown by line **288**. The quote object **250** then informs market-maker of the fill through the use of a trade report service module (not shown).

In addition, at steps **286** and **287**, the quote service module may modify quotes in response to the trade in accordance with the market-maker's trading parameters, as discussed below. The quote service module then reports the new quotes to the broker service module **230** as shown by line **290**. The broker service **230** acknowledges the quote updates as shown by line **292**. If the broker service **230** has already processed additional trades against the original quote, then the broker service module **230** would respond with a "too late to cancel" message. Once the update acknowledge has been received, the quote service module **240** updates the quote objects **250**, **252**, as shown by lines **294**, **296**. The quote objects then inform the market-maker that its quotes have been updated.

Risk Measurements and Risk Thresholds

In a preferred embodiment of the automated trading system **100** having integrated order modification and quote risk monitoring, the aggregate risk of a market-maker's recent trades is calculated after each trade. The measurement preferably includes either calculating an equivalent stock position, i.e., a net delta (by, for example, summing delta values for all contracts traded by the market-maker associated with the option series in the class), or calculating a net gamma, theta, or vega.

In particular, the aggregate risk measurement is preferably the net delta of all the trades for a specific market-maker or a designated group of market-makers in a given class in a given period of time. The quotes in a given class submitted by a market-maker (or a group of market-makers) are referred to herein as a quote group. The rules for delta calculations are as listed below:

Calls (delta value Δ is positive)
- Market-maker selling
- Market-maker position will be Negative Delta
- Market-maker buying
- Market-maker position will be Positive Delta

Puts (delta value Δ is negative)
- Market-maker selling
- Market-maker position will be Positive Delta
- Market-maker buying
- Market-maker position will be Negative Delta

The aggregate risk net delta is defined as:

$$\Delta_{NET} = \sum_i S_i \cdot \Delta_i \cdot U_i \cdot K_i, \quad (1)$$

which is the summation for i trades of the product of S, the sign of the trade, where S is positive when a market-maker buys and negative when a market-maker sells, Δ (delta), which is rate of change of the price of the individual series with respect to the stock, and ranges from −1.0 to 0 for puts and 0 to 1.0 for calls, U, which is the unit of trade, i.e. the number of shares, and K, the number of contracts traded by the market-maker.

The aggregate risk measurement is preferably based on the net delta Δ_{NET} for the entire class of options, which is the sum of all the deltas for a given market-maker's trades in all series of a class. The delta contribution for each trade is calculated every time a trade occurs for any series in the class. The aggregate risk is then calculated by summing delta contribu-

tions from only the most recent trades. The values for the theoretical deltas Δ, are preferably obtained by an autoquote system (not shown) associated with the exchange system **100**, and more particularly with the business services package **132**.

Autoquote systems provide pricing information, and specifically theoretical delta values Δ_i, using well-known algorithms that utilize standard parameters, as is understood to those of skill in the art. Most of the parameters associated with calculating an individual series delta value are objective data, such as the date, strike price, the price of the underlying security, etc. Other autoquote parameters have acceptable default values that may be used, such as using the broker loan rate for the interest rate, etc. One parameter that may be more subjective among individual market-makers is the volatility parameter. Thus, the system **100** may be designed such that each quote submitted by a market-maker includes a volatility field to be used by the system in determining the individual theoretical delta value Δ_i. The theoretical delta value Δ_i may then be calculated either as part of the threshold test, or may be periodically updated at a rate sufficient to provide a fairly accurate delta value Δ_i. In this way, the system **100** provides the market-maker with further control over the quote risk monitoring system.

Because the exchange quote modification service is intended to address increased risks associated with a rapid sequence of trades, older trades need not be included because the market-maker has had an opportunity to manually intervene and modify his quotes. Thus, the aggregate risk measurement may be based on the last N trades, where N is a trading parameter specified by the market-maker, or may be based on trades occurring within a specific time frame. The duration of the time frame may be specified by the market-maker by providing a time window parameter t_K, which is included as a trading parameter. Alternatively, a default value for t_K may be used.

Alternatively, the risk threshold and risk measurement may include an aggregate gamma measurement. Gamma is known to those of skill in the art to be the rate of change of the delta parameter with respect to the rate of change of the underlying security, such as the stock. An aggregate gamma measurement provides an indication of the rate at which an aggregate delta measurement will change. Net gamma values are negative when a market-maker is a net seller of contracts, and positive when a market-maker is a net buyer of contracts. As a further alternative, either theta, which is the rate at which option prices change over time, or vega, which is the change in an option contract that results from a change in its volatility, may be included.

The market-maker may provide a single threshold Δ_{NETMAX} such that if the absolute value of the aggregate risk exceeds the threshold, then the quotes are modified according to the rules set forth below. The market-maker may also provide positive and negative thresholds Δ^+_{NETMAX} and Δ^-_{NETMAX} to accommodate a market-maker's pre-existing risk bias.

In an alternative preferred embodiment, the market-maker's risk is determined by calculating the net contract volume traded within a specified time. The net contract volume K_{NET} may be calculated by using equation (1) above, with the exception that the delta value is replaced by the sign of Δ, or ±1, where calls are positive 1, and puts are negative 1:

$$K_{NET} = \sum_i S_i \cdot \text{sign}(\Delta_i) \cdot U_i \cdot K_i, \text{ for each trade, } i. \quad (2)$$

The result is that the volume of each trade is treated as a positive or negative value, depending upon the nature of the trade—selling calls and buying puts have negative contributions, and buying calls and selling puts have positive contributions. The sum of the trades is then calculated to provide a net difference between the number of short calls plus long-puts and long calls plus short puts. Thus, the market-makers may specify a threshold in terms of a maximum net contract volume offset, K_{NETMAX} (or positive and negative thresholds K^+_{NETMAX} and K^-_{NETMAX} to accommodate a market-maker's pre-existing risk bias). As stated above, the system may be configured to also allow the market-makers to specify a time window parameter t_K that specifies which trades should be included in the risk calculation. Thus, only the contracts K that have been executed within the previous t seconds will be included in equation 2. Alternatively, the system may be configured to specify i, the number of previous trades to include in the risk calculation.

In still further embodiments, the aggregate risk measurement may be simplified by calculating the total number of put or call contracts (or deltas) that have been sold or bought within a given time frame or within that last N trades. Thus, for example, when a market-maker has just sold a put, the quote service module **240** may calculate the total number of puts sold (or the delta due to all the puts sold) within the given trading window and compare it to a threshold. If the next trade is a call purchase, then the system would calculate the contracts or deltas for the calls purchased. Thus, if any of the four aggregate volume quantities (buying calls, selling calls, buying puts, selling puts) exceeds a threshold (within a certain time period, or certain number of trades), the quote-modification module **340** modifies the quotes appropriately. Alternatively, the quote service module **240** may calculate the total calls bought plus puts sold, and the total calls sold plus puts bought, and notify the quote modification module **340** if either of these aggregate values exceeds the threshold. As a further alternative, the quote service module may use a weighting scheme to calculate aggregate values described above. Specifically, in-the-money options (options with intrinsic value) may be weighted more heavily than at-the-money or out-of-the-money options. In one preferred method, the in-the-money options are weighted with a factor of two, at-the-money options are weighted with a factor of one, and out-of-the-money options are weighted by a factor of one half. These simplified risk measurement and threshold tests perform adequately due to the nature of trading activities that typically result in large risk exposure.

It should also be noted that the market-makers may be grouped together for purposes of risk exposure analysis. That is, the total risk may be calculated based on the trades of one or more market-makers. The market-makers provide a group identification parameter(s) indicating which other market-makers' trades should be included in the risk calculation. In this manner, market-makers acting in concert on behalf of a single organization may coordinate their quote modification.

Automatic Quote Modification

The quote service module **240** of the exchange system **100** includes a quote modification service module **340**. The quote modification service module **340** may be implemented as part of the quote service module **240**, or may be a separate service module. It may also take the form of a separate quote factory module for generating new instantiations of quote objects. The quote modification service module **340** performs quote modification by preferably automatically revising, canceling, or regenerating quotes. The quote modification service module **340** resides on the exchange system computer **104**, **106**, or computer cluster **102**. The quotes are modified by the

exchange system in an automatic manner that does not require further input from the market-maker in the form of quote cancellation requests and submission of new quotes by the market-maker or his computer. In this way, the exchange system performs quote modification immediately and without the transmission delays inherent in communication systems and without delays associated with processing queued cancellation requests received from a remote location.

If the quote service module **240** determines that the threshold(s) have been exceeded, the quote service module **240** determines revised quotes and forwards them to the broker service module **230** and the quote objects **250**, **252**. The revised quotes can take numerous forms. In a first embodiment, the quote service module **240** revises quotes by canceling all outstanding quotes in the class, thereby preventing any further trades from executing and giving the market-maker time to provide revised quotes. In this embodiment, the quote service module **240** sends quote update messages **290** in the form of cancellation messages to the broker service module **230**. The broker service **230** then removes those quotes from the electronic book. Because the threshold test is performed by the exchange system **100** after each trade, the cancellation messages are therefore preferably processed before any further trades can be executed. This is possible because the cancellation requests are not sent from a remote node on a wide area network, such as a market-maker's computing platform, but are generated by the exchange system **100**. This provides the advantage of eliminating a cancellation message queue, as would be used when sending cancellation requests from a remote node, thereby improving quote update times and providing risk management.

In a second embodiment, the quote service module **240** revises quotes by reducing the quantity associated with the existing quotes in the class thereby reducing the amounts of potential further trades and reducing the market-maker's exposure to more risk. The market-maker may specify the amount of the volume decrease by way of an increment value. In this embodiment, the quote service module **240** sends quote updates **290** by first sending quote cancellation messages to the broker service module **230**, and after acknowledgment, sending the revised quotes to the broker service module **230** for execution or booking. Again, because the threshold test is performed by the exchange system **100** after each trade, the cancellation messages are therefore preferably processed before any further trades can be executed. As above, this is possible because the cancellation requests are not sent from a remote node on a wide area network, such as a market-maker's computing platform, but are generated by the exchange system **100**.

In a third embodiment, the quote service module **240** revises quotes by decreasing the bid and offer values of some quotes and increasing others in an attempt to cancel some of the risk already assumed by the market-maker. The quote service **240** does this by automatically adjusting quotes to favor trades that will tend to provide offsetting risk. Specifically, if the threshold (K_{NETMAX} or Δ_{NETMAX}) has been exceeded by a high positive-valued net delta (or K), then the net delta (or K) may be offset by trades having a negative delta (or K). As set forth above, those trades would include selling calls and buying puts. Similarly, if the threshold has been exceeded by a high negative-valued net delta (or K), then the aggregate risk may be offset by trades having a positive delta (or K), or by selling puts and buying calls. Of course, to produce the desired trades, the lowering of offer values of quotes will tend to result in more selling activity by the market-maker, and the raising of bid values will result in more buying activity by the market-maker. In this embodiment, the modification increment is specified by an increment value. As in the previous embodiment, the quote service module **240** sends quote updates **290** by sending quote cancellation messages to the broker service module **230**, and after acknowledgment, sending the revised quotes to the broker service module **230** for execution or booking. Again the automated risk monitoring system and quote modification service of system **100** provides advantages in that the market-maker need not cancel previous quotes and submit new quotes while still being exposed to the possibility of further trades being executed.

The quote service **240** may also modify quotes by regenerating the just-filled quote. This may be performed even if the market-maker's risk threshold has not been exceeded. The market-maker is able to specify quote regeneration parameters via client application server **210** that are stored in the user service module **260**. The parameters specify which products are enabled for quote regeneration, and the extent to which the quotes are to be regenerated. The market-maker may therefore specify, on a product-by-product basis, how many times the quotes are to be regenerated after each quote has been filled. This is referred to herein as the regeneration number parameter. The market-maker may also specify whether the regenerated quotes are to have the same bid and offer values, or are to be backed-off from the previous trade. This parameter is referred to herein as the regeneration increment. That is, for a two-sided quote, if the market-maker has just sold a quantity of contracts at his offer price, the regenerated quote may have a higher offer value. Preferably the bid value is also raised accordingly to maintain a desired or required spread in bid and offer quotes. If, on the other hand, the market-maker has just bought a quantity of contracts at his bid price, the regenerated quote may have a lower bid value. The market-maker also has the option of specifying on a per-class basis the values of the regeneration number parameter and the regeneration increment parameter. The quote regeneration is preferably not performed if the market-maker risk threshold has been exceeded, unless the market-maker has specifically selected quote revision in the event the risk threshold has been exceeded.

With reference to FIG. **4**, the method of quote modification **300** will be described. Upon execution of a trade at step **310**, the quote service module **240** at step **320** checks to see whether the individual market-maker's risk threshold has been exceeded. As mentioned above, the risk measurement and threshold test may be performed using a variety of methods, and certain market-makers' trading activities may be combined for the purposes of risk exposure. If the threshold has not been exceeded, then at step **330** the quote service module **240** preferably checks to see whether the market-maker whose quote has been executed has indicated the desire to have his quotes regenerated. If not, then the process has completed. In the event that the result of either inquiry **320**, **330** is affirmative, then the quote service **240** modifies the quotes with the quote modification module **340** as described above.

Quote modification module **340** includes quote regeneration module **350** and cancel or revise quote module **360**. As mentioned above, the quote modification module **340** may be integral to quote service module **240**, or may be included in a quote factory module, or may be a separate service module. The quotes are regenerated, cancelled, or revised, for example as described above, and submitted as shown in step **370** to the broker service module **230** for execution.

Preferred embodiments of the present invention have been described herein. It is to be understood, of course, that changes and modifications may be made in the embodiments

without departing from the true scope of the present invention, as defined by the appended claims. The present embodiment preferably includes logic to implement the described methods in software modules as a set of computer executable software instructions. A Central Processing Unit ("CPU"), or microprocessor, implements the logic that controls the operation of the transceiver. The microprocessor executes software that can be programmed by those of skill in the art to provide the described functionality.

The software can be represented as a sequence of binary bits maintained on a computer readable medium including magnetic disks, optical disks, and any other volatile or (e.g., Random Access memory ("RAM")) non-volatile firmware (e.g., Read Only Memory ("ROM")) storage system readable by the CPU. The memory locations where data bits are maintained also include physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the stored data bits. The software instructions are executed as data bits by the CPU with a memory system causing a transformation of the electrical signal representation, and the maintenance of data bits at memory locations in the memory system to thereby reconfigure or otherwise alter the unit's operation. The executable software code may implement, for example, the methods as described above.

It should be understood that the programs, processes, methods and apparatus described herein are not related or limited to any particular type of computer or network apparatus (hardware or software), unless indicated otherwise. Various types of general purpose or specialized computer apparatus or computing device may be used with or perform operations in accordance with the teachings described herein.

It should be understood that a hardware embodiment may take a variety of different forms. The hardware may be implemented as an integrated circuit with custom gate arrays or an application specific integrated circuit ("ASIC"). Of the course, the embodiment may also be implemented with discrete hardware components and circuitry. In particular, it is understood that the logic structures and method steps described herein may be implemented in dedicated hardware such as an ASIC, or as program instructions carried out by a microprocessor or other computing device.

The claims should not be read as limited to the described order of elements unless stated to that effect. In addition, use of the term "means" in any claim is intended to invoke 35 U.S.C. §112, paragraph 6, and any claim without the word "means" is not so intended. Therefore, all embodiments that come within the scope and spirit of the following claims and equivalents thereto are claimed as the invention.

We claim:

1. A system for processing trades of securitized instruments based on security orders and quotes received from client computers, comprising:

at least one server computer comprising a memory, and a processor, said server computer configured to perform the steps of:

receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a risk threshold;

generating a trade by matching said received orders and quotes to previously received orders and quotes;

storing each of said orders and quotes when a trade is not generated;

determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a risk level and an aggregate risk level associated with said trade;

comparing said aggregate risk level with said risk threshold; and,

automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said threshold is exceeded.

2. The apparatus of claim **1** further comprising a quote data structure stored in said first memory, said data structure containing a plurality of quotes fields and at least one risk threshold field.

3. The apparatus of claim **2**, wherein said plurality of quote fields comprises a bid quote field and an offer quote field.

4. The apparatus of claim **2**, wherein said data structure further comprises a group indicator field.

5. The apparatus of claim **2**, wherein said data structure further comprises a quote modification increment field.

6. The apparatus of claim **2**, wherein said data structure further comprises a quote regeneration increment field.

7. The apparatus of claim **2**, wherein said data structure further comprises an owner field.

* * * * *

ADDENDUM 6

U.S. Patent No. 8,266,044,
Case CBM2013-00051 (PTAB) (Exhibit 1001)

A125 – A142

2015-1728, -1729 & -1730

Chicago Board Options Exchange, Incorporated
v.
International Securities Exchange, LLC

US008266044B2

(12) **United States Patent**
Kaminsky et al.

(10) **Patent No.: US 8,266,044 B2**
(45) **Date of Patent: Sep. 11, 2012**

(54) **AUTOMATED TRADING EXCHANGE SYSTEM HAVING INTEGRATED QUOTE RISK MONITORING AND INTEGRATED QUOTE MODIFICATION SERVICES**

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(73) Assignee: **Chicago Board Options Exchange, Incorporated**, Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/178,289**

(22) Filed: **Jul. 7, 2011**

(65) **Prior Publication Data**

US 2012/0095898 A1 Apr. 19, 2012

Related U.S. Application Data

(63) Continuation of application No. 12/035,996, filed on Feb. 22, 2008, now Pat. No. 7,980,457, which is a continuation of application No. 09/475,534, filed on Dec. 30, 1999, now Pat. No. 7,356,498.

(51) **Int. Cl.**
G06Q 40/00 (2006.01)

(52) **U.S. Cl.** **705/37**

(58) **Field of Classification Search** ..... 235/375, 235/376, 379; 705/36 R, 37–41

See application file for complete search history.

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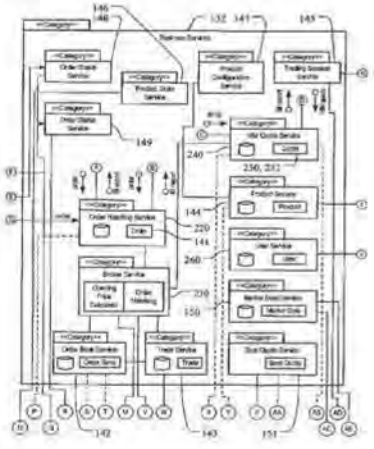
Primary Examiner — Andrew Joseph Rudy
(74) *Attorney, Agent, or Firm* — Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

An automated trading exchange having integrated quote risk monitoring and quote modification services. An apparatus is implemented using at least one computer, having memory, and a processor. The computer is configured to receive orders and quotes, wherein specified ones of the quotes are contained in a quote group, and have associated trading parameters such as a risk threshold. Not all received quotes are required to have trading parameters as described herein. Preferably, the quote group contains all the quotes, or a subset of quotes, belonging to an individual market-maker for a given class of options contracts, or possibly the quotes of two or more market-makers that have identified themselves as belonging to a group for the purposes of risk monitoring and quote modification. The computer typically generates a trade by matching the received orders and quotes to previously received orders and quotes, and otherwise stores each of the received orders and quotes if a trade is not generated. The computer then determines whether a quote within the quote group has been filled as a result of the generated trade, and if so, determines a risk level and an aggregate risk level associated with said trade. The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically modifies at least one of the remaining quotes in the quote group. The computer may also automatically regenerate quotes that have been filled.

3 Claims, 7 Drawing Sheets



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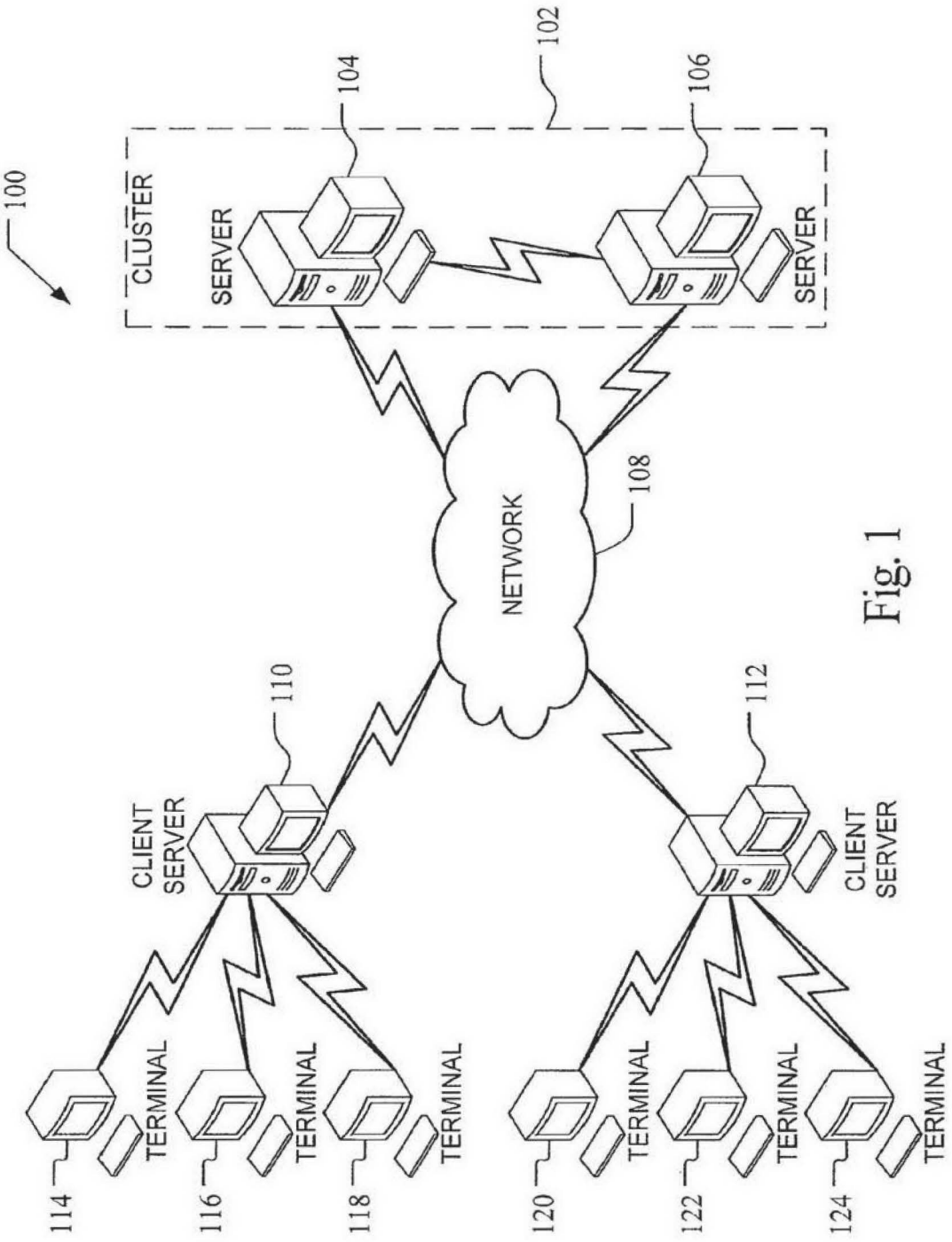

Fig. 1

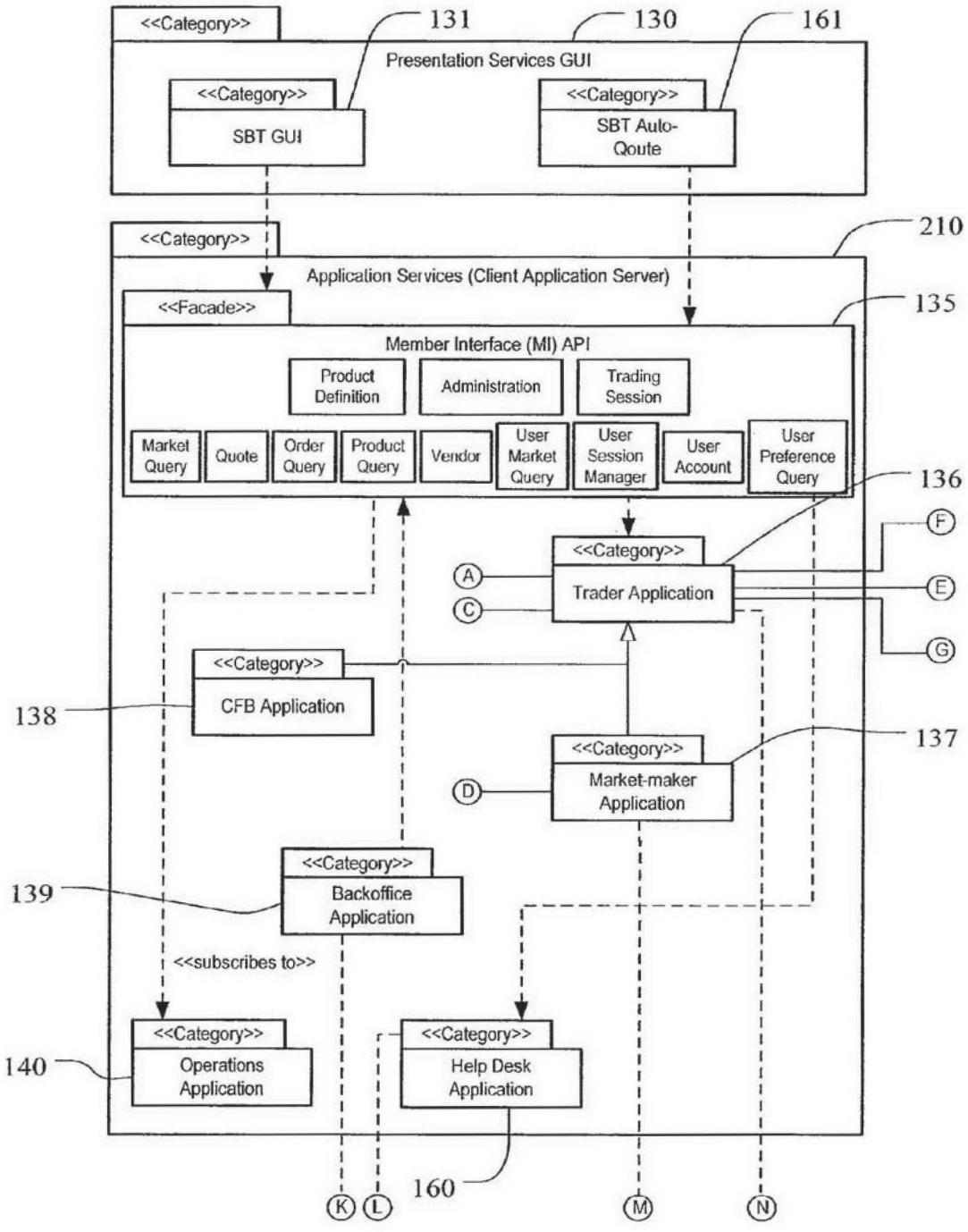
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Fig. 2A

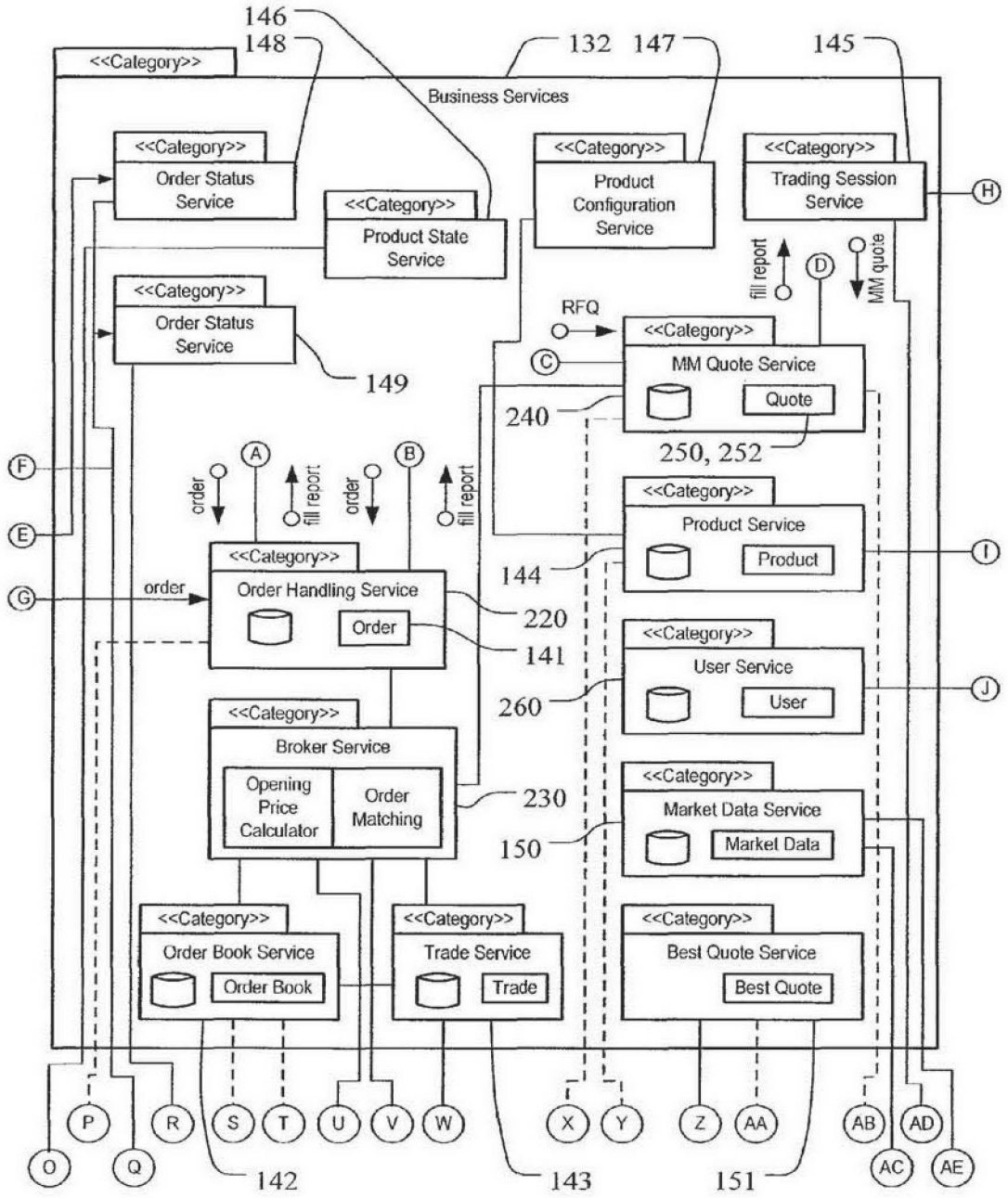
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Fig. 2B

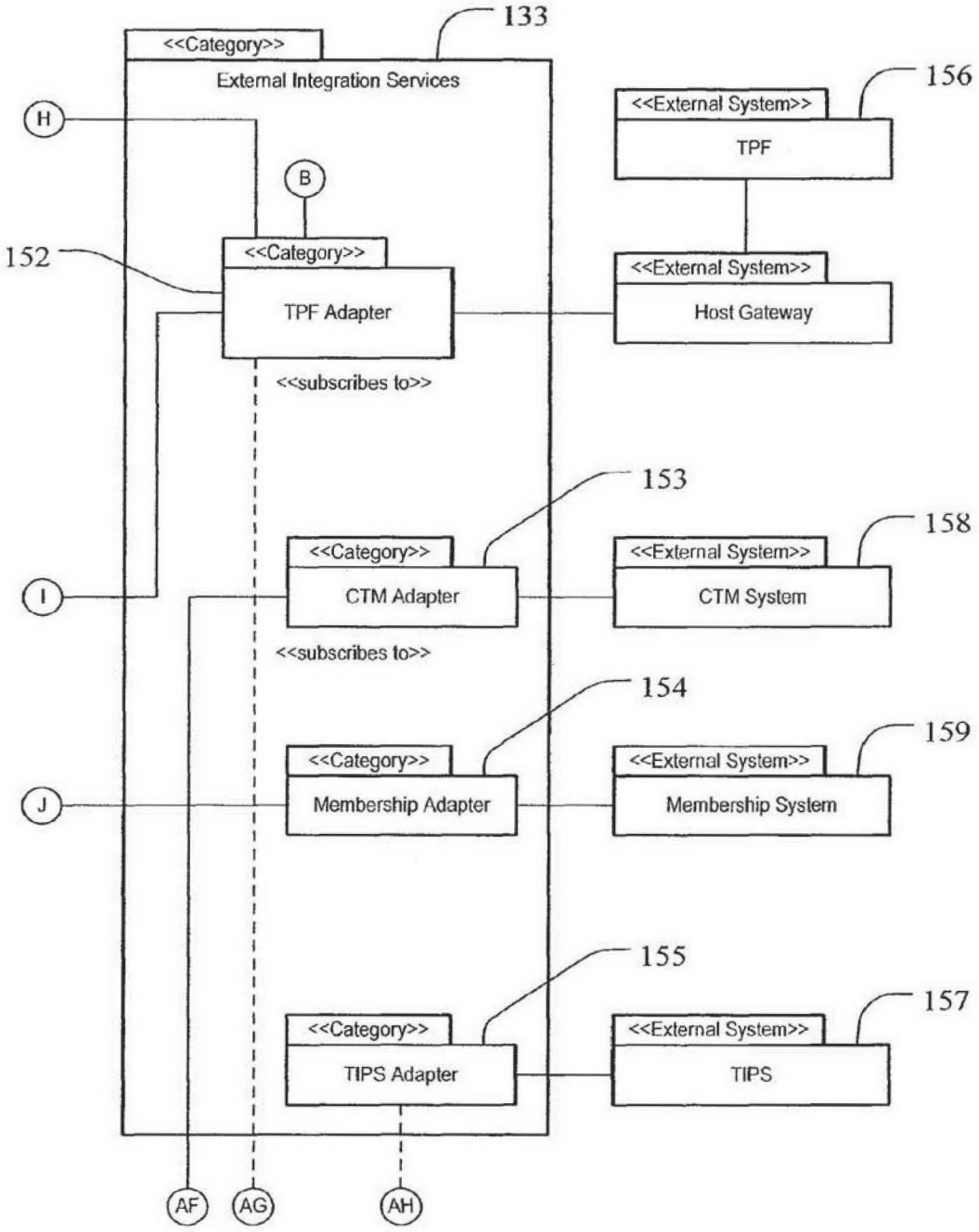
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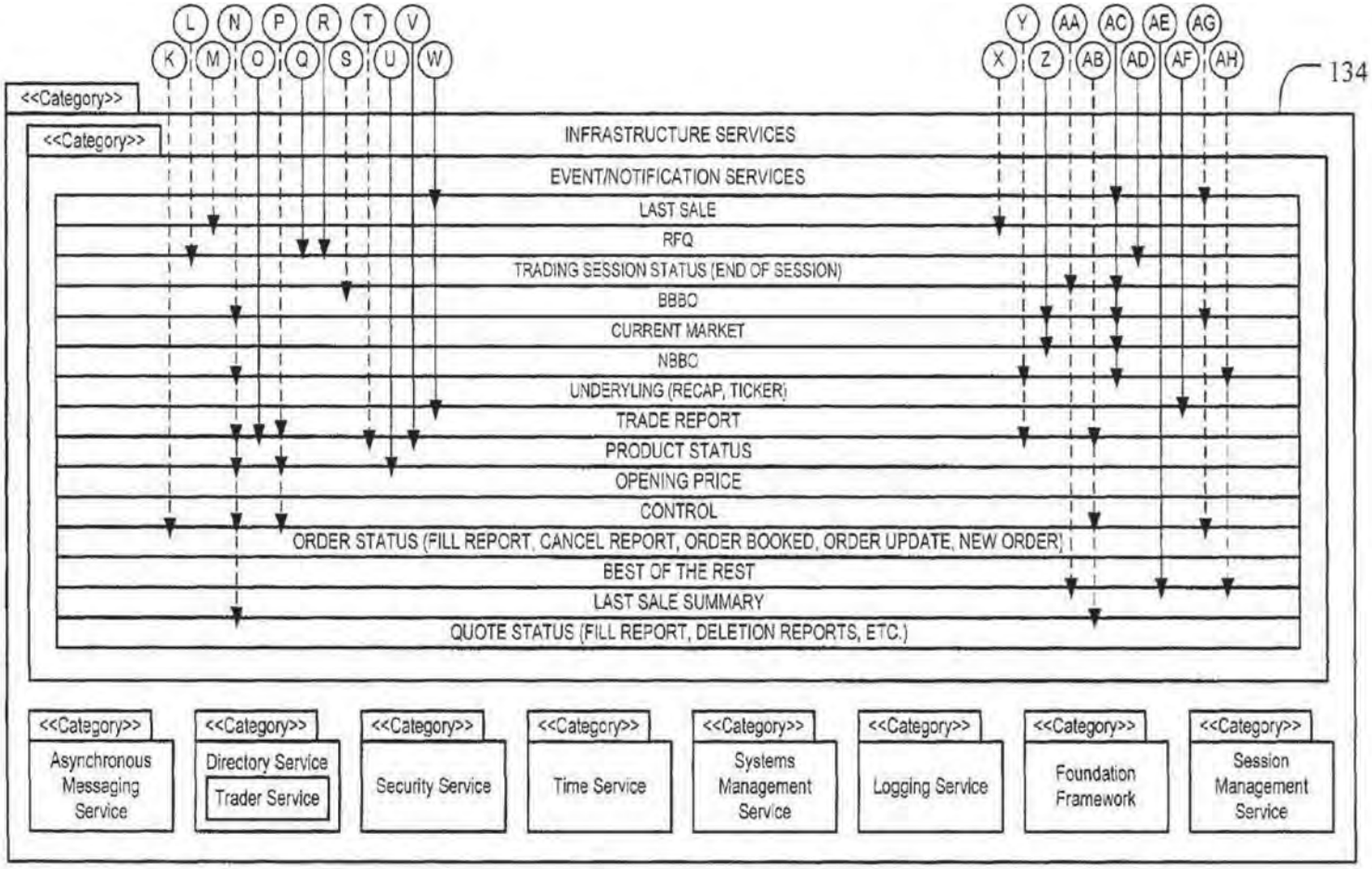
Fig. 2C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W
X
Y
Z
AA
AB
AC
AD
AE
AF
AG
AH
134
<<Category>>
<<Category>>
INFRASTRUCTURE SERVICES
EVENT/NOTIFICATION SERVICES
LAST SALE
RFQ
TRADING SESSION STATUS (END OF SESSION)
BBBO
CURRENT MARKET
NBBO
UNDERLYING (RECAP, TICKER)
TRADE REPORT
PRODUCT STATUS
OPENING PRICE
CONTROL
ORDER STATUS (FILL REPORT, CANCEL REPORT, ORDER BOOKED, ORDER UPDATE, NEW ORDER)
BEST OF THE REST
LAST SALE SUMMARY
QUOTE STATUS (FILL REPORT, DELETION REPORTS, ETC.)
<<Category>>
Asynchronous Messaging Service
<<Category>>
Directory Service
Trader Service
<<Category>>
Security Service
<<Category>>
Time Service
<<Category>>
Systems Management Service
<<Category>>
Logging Service
<<Category>>
Foundation Framework
<<Category>>
Session Management Service

Fig. 2D

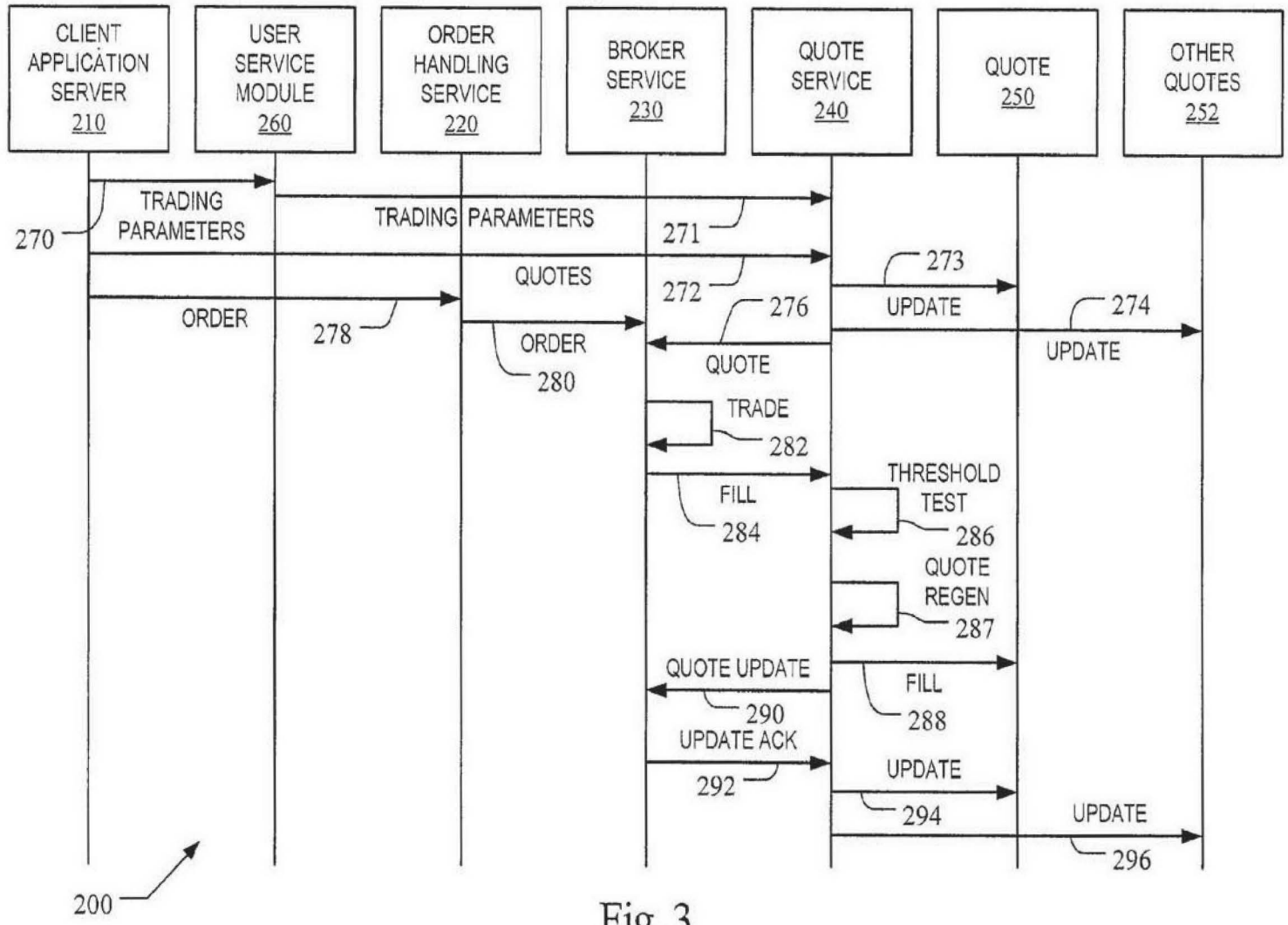
CLIENT APPLICATION SERVER 210
USER SERVICE MODULE 260
ORDER HANDLING SERVICE 220
BROKER SERVICE 230
QUOTE SERVICE 240
QUOTE 250
OTHER QUOTES 252
TRADING PARAMETERS
270
TRADING PARAMETERS
271
QUOTES
272
273
UPDATE
274
UPDATE
ORDER
278
ORDER
280
276
QUOTE
TRADE
282
FILL
284
THRESHOLD TEST
286
QUOTE REGEN
287
QUOTE UPDATE
290
FILL
288
UPDATE ACK
292
UPDATE
294
UPDATE
296
200

Fig. 3

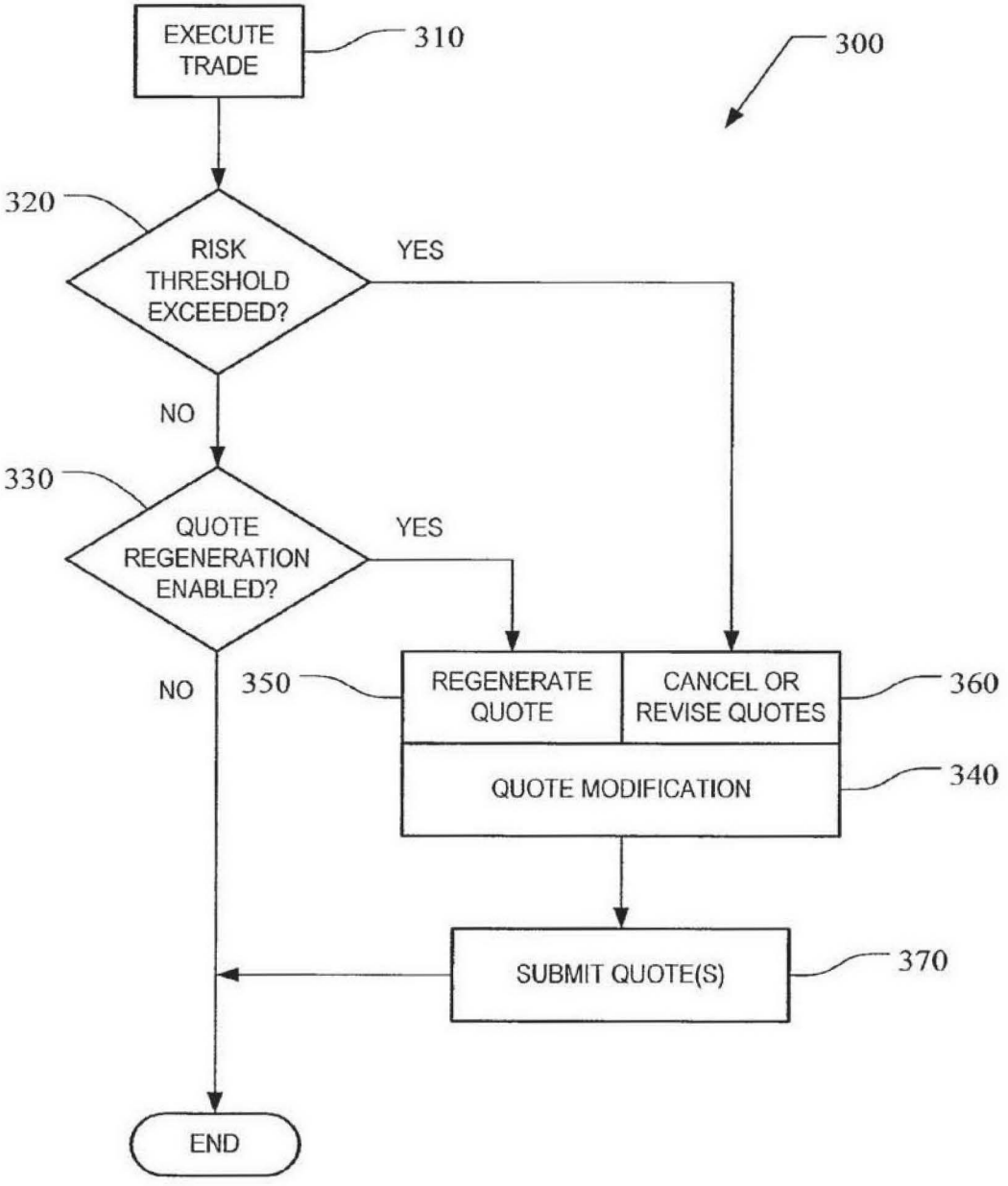
EXECUTE TRADE
310
300
320
RISK THRESHOLD EXCEEDED?
YES
NO
330
QUOTE REGENERATION ENABLED?
YES
NO
350
REGENERATE QUOTE
CANCEL OR REVISE QUOTES
360
QUOTE MODIFICATION
340
SUBMIT QUOTE(S)
370
END

Fig. 4

AUTOMATED TRADING EXCHANGE SYSTEM HAVING INTEGRATED QUOTE RISK MONITORING AND INTEGRATED QUOTE MODIFICATION SERVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 12/035,996, filed Feb. 22, 2008 now U.S. Pat. No. 7,980,457, which is a continuation of U.S. application Ser. No. 09/475,534, filed Dec. 30, 1999, now U.S. Pat. No. 7,356,498, wherein each of the aforementioned applications are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

The present invention relates to financial trading systems. More specifically, it is directed to a method and device for market-maker risk management through automatic quote risk monitoring and quote modification in an automated trading system.

DESCRIPTION OF THE RELATED ART

1. Option Trading

Option contracts are traded publicly on many exchanges throughout the world. These securities, referred to generally as "options," convey certain rights to buy or sell an underlying stock, commodity, or other security at a fixed price for a specific period of time—until expiration for an American-style option or at expiration for a European-style option. All option contracts that trade on U.S. securities exchanges are issued, guaranteed and cleared by the Options Clearing Corporation (OCC). OCC is a registered clearing corporation with the SEC.

The potential loss to the buyer of an option can be no greater than the initial premium paid for the contract, regardless of the performance of the underlying stock. This allows an investor to control the amount of risk assumed. On the contrary, the seller of the option, in return for the premium received from the buyer, assumes the risk of being assigned the obligation to buy or sell the underlying security if the contract is exercised. Therefore, writing options can lead to large potential exposure.

Further background information may be obtained from the book "OPTIONS, Special Concepts and Trading Strategies," The Options Institute, The Educational Division of the Chicago Board Options Exchange, Second Edition, McGraw Hill (1995), the contents of which are incorporated herein by reference.

2. Open Outcry Trading and Automated Exchanges

Many trading systems utilize what is known as an open outcry method of trading. In the open outcry system, market-makers are required to make a two-sided market by providing a bid and offer quote in all option series. The market-makers typically communicate verbally or visually with contra traders indicating their willingness to buy and sell various quantities of securities. Because the market-makers have personal control over the types and number of contracts traded, they can adjust their trading strategies as their positions change. In this way, the market-makers can manage their exposure, or risk, associated with their holdings by adjusting their quotes to favor trades that would tend to hedge away unwanted exposure.

In an automated trading environment, a certain amount of control is lost when a market-maker has issued quotes in a large number of option series. The quotes are typically recorded in the automated and computer-based trading system, and matched up automatically with orders that enter the system electronically. With the proliferation of computer trading systems and increased communication speeds, the rate at which trades may be executed by an automated system far surpass the rate of trades that occur in, an open outcry system. The speeds are such that the rapidity of trades may exceed the market-maker's ability to adapt his or her position. Specifically, one disadvantage of automated trading systems is that a number of automatic trades may occur within a very short time that result in an unacceptable risk being assumed by a market-maker. That is, the trades may occur so rapidly that the market-maker is unable to withdraw or modify his quotes in a timely manner.

There exist software tools that can analyze stock and option portfolios in close to real time. Market data is provided to the software analysis tools and used to evaluate the risk associated with stock and option portfolios. In addition, the tools may provide recommendations for trades and quotes and automated submission of those trades and quotes. However, even if a market-maker utilizes such a computer-implemented automated position analysis tool to revise or cancel quotes, the software tools may be unable to act in time given the speed at which an automated trading exchange system is capable of executing incoming orders. In particular, one aspect of existing exchange systems is that transactions are received and processed in the order received. Thus, even if a market-maker responds immediately using an automated software tool, the exchange may have a message queue containing additional orders that will be processed before the exchange system receives and processes the market-maker's quote cancellation request.

The result is that a market-maker who is willing to take on a predetermined level of risk must limit the number of quotes or the depth (quantity) of each quote to ensure that rapid trades do not result in an unacceptable aggregate risk, rather than issuing quotes having greater depth and breadth (where the filling of a single quote might reach the market-maker's risk limit). Thus, a market-maker's limited control over risk management may have the undesirable effect of hindering the liquidity of the market.

It would therefore be desirable to have a trading exchange system and method for automatically canceling, regenerating, or modifying quotes under certain trading conditions.

SUMMARY OF THE INVENTION

A method and apparatus for an automated trading exchange having integrated quote risk monitoring and quote modification services is provided. In accordance with a first aspect of the invention, an apparatus is implemented using at least one computer, having memory, a processor, and a communication port. The computer is configured to receive orders and quotes, wherein specified ones of the quotes are contained in a quote group, and have associated trading parameters such as a risk threshold. Note that not all received quotes are required to have trading parameters as described herein. Preferably, the quote group contains all the quotes belonging to an individual market-maker for a given class of options contracts, or possibly the quotes of two or more market-makers that have identified themselves as belonging to a group for the purposes of risk monitoring and quote modification. The computer typically generates a trade by matching the received orders and quotes to previously received orders and quotes, and otherwise stores each of the received orders and quotes if a trade is not generated. The computer then

determines whether a quote within the quote group has been filled as a result of the generated trade, and if so, determines a risk level and an aggregate risk level associated with said trade. The computer then compares the aggregate risk level with the market-maker's risk threshold, and if the threshold is exceeded, automatically modifies at least one of the remaining quotes in the quote group. The computer may also automatically regenerate quotes, that is, automatically issue new quotes when trades have occurred against previous quotes.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features and advantages of the present invention will be more readily appreciated upon reference to the following disclosure when considered in conjunction with the accompanying drawings, in which:

FIG. **1** depicts a preferred embodiment of the quote modification trading system;

FIGS. **2**A, **2**B, **2**C, and **2**D show the interconnection of various software modules associated with the quote risk monitoring and modification trading system;

FIG. **3** shows a sequence diagram of a preferred embodiment of the quote modification system; and

FIG. **4** shows a flowchart depicting the method of modifying quotes.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT(S)

With reference to FIG. **1**, a preferred embodiment of the system **100** utilized for trading and quote modification is described. The system **100** (also referred to herein as a screen-based trading system, or SBT system) includes a plurality of computers, which may be one or more workstations, servers, mainframes, or other computer hardware platforms that provide sufficient resources to meet the desired trading volume and desired transaction-processing rate. In the preferred embodiment shown in FIG. **1**, the system includes a number of computer clusters such as cluster **102** (although only one is depicted in FIG. **1**), where each cluster **102** handles trading for a number of securities, such as one or more classes of options. In the preferred embodiment, each cluster **102** is made up of two servers **104**, **106**. The servers **104**, **106** are preferably multiprocessor SUN **4500** servers available from SUN Microsystems of Palo Alto, Calif. SUN Enterprise™ servers or Starfire™ servers are a preferable alternative.

The servers **104** and **106** in cluster **102** communicate with a plurality of client servers **110**, **112** that are typically located at remote locations, such as at a brokerage house, but may also be located in the same facility as the clusters **102**. Network **108** facilitates communication between the clusters **102** and the client servers **110**, **112**. The network **108** is preferably a private LAN/WAN configuration, but a public network may be utilized, provided sufficient redundancies and message security are provided. Two such client servers **110**, **112** are shown in FIG. **1**. Each client server **110**, **112** may be provided with a predetermined message throughput rate into network **108**, where the throughput rate may be a maximum rate determined by various parameters, including the volume of orders sent by the client server **110**, **112**, the volume of quotes sent by the client server **110**, **112**, the number of option series for which quotes are provided, communication/connection fees paid by the brokerage house or other entity utilizing the client server **110**, **112**, the overall capacity of the trading system **100**, etc. The client servers **110**, **112** preferably communicate with other elements of the automated exchange system using a client application server module **210**, as further described below, running on client servers **110**, **112**.

Each client server **110**, **112** is capable of serving a number of clients, shown as terminals **114**, **116**, **118**, **120**, **122**, and **124** in FIG. **1**. The client terminals **114-124** may be "dumb" terminals, stand alone computing devices (PCs or workstations), or even portable wireless terminals. The client servers **110**, **112** may communicate with the client terminals **114-124** using a proprietary protocol or one of many standard public domain protocols. The client servers **110**, **112** may include a web server or connect to a separate web server for processing tcp/ip, http, html, java, and the like, and provide access to client terminals **114-124** over the Internet in addition to (or as an alternative to) private LAN/WAN or Virtual Private Network access. For embodiments that include a webserver, the web server preferably utilizes common gateway interface scripts (cgi) to interface with the client application server **210**. In addition to cgi scripts, or as an alternative to cgi, other web server interfaces and server extensions may be utilized to provide communication between the web server and the application server **210**. The client servers **110**, **112** communicate with the users of terminals **114-124** by way of secure Internet communication protocols or by private LAN/WAN or VPN communication links. Thus the client terminals **114-124** may run dedicated proprietary software to communicate with the client server **110**, **112**, or may interface with client servers **110**, **112** via a standard web browser. The web browser may operate using built-in java scripts, or may also include specialized browser modules that are provided to the client terminals.

The automated exchange system **100** is comprised of the following five logical software modules: Presentation Services Graphical User Interface (GUI) **130** (FIG. **2**A); Application Services **210** (Client Application Server, Gateway) (FIG. **2**A); Business Services **132** (FIG. **2**B); External Integration Services **133** (FIG. **2**C); and, Infrastructure Services **134** (FIG. **2**D).

With reference to FIG. **2**A, the Presentation Services GUI module **130** is constituted by applications that interact with the exchange system **100** via the Member Interface (MI) API **135**. There are two types of client applications, those that provide a GUI to allow user interaction with the system directly and applications that automate trading functions.

An SBT (screen-based trading) GUI module **131** is responsible for displaying the contents of a particular model to the screen and updating the display if the model's contents change. This module **131** contains several GUI applications, one for each of the major classes of human actors that use the system **100**: traders, market-makers, clearing firm brokers, and system operators. The Trader GUI is used by regular traders. It consists of several GUI's for displaying and entering orders, and market data. The Market-Maker GUI is an extension of the Trader GUI and is used by market-makers. It consists of several GUI's for displaying and entering orders, quotes, and market data. The Clearing Firm Broker GUI is an extension of the Trader GUI and used by clearing firm brokers. It consists of several GUI's for forcing the logout of a market-maker and for setting a maximum order quantity for the quotes and orders of the clearing firm's market-makers. The system operation GUI is used by system operators and help desk operators. The autoquote system **161** runs on the market-maker's work station and is used by the market-maker to generate quotes for various option series.

The Application Services module **210** contains subordinate modules that forward requests initiated by human or automated actors, to be executed by the appropriate Business Services module(s) **132**. These applications submit requests

to Business Services components **132**, notify clients of business events, and maintain user-specific views of information in the Business Services **132**. This module also encompasses a Member Interface (MI) API **135** that provides a single entry point to the system exposing the applications in the Application Services Module **210** (i.e., Trader, Market-Maker). In addition, the Application Services Module **210** maintains instantaneously updated views that reflect the prevailing state of each actor's information in the Business Services module **132**.

The Trader Application module **136** has the following specific responsibilities: submit, cancel, update, and cancel/replace orders; submit requests for quotes; present the current status of the trader's orders; present fill and cancel reports; present Market Best Bids and Offers for selected products; set the trader's defaults and preferences; present Book Depths for selected products; and, present underlying quotes/last sales and news alerts.

The Market-Maker module **137** inherits the Trader App module's **136** responsibilities and adds the following: submit and modify market-maker quotes; present requests for quotes; set the market-maker's defaults and parameters; set autoquote parameters; submit autoquotes.

The Clearing Firm Broker module **138** inherits the Trader App module's **136** responsibilities and adds the following: assume control of a trader's privileges. A Clearing Firm Broker can force the logout of a market-maker; set a maximum order quantity for quotes and orders of the clearing firm's market-makers.

The BackOffice application **139** is responsible for reporting order status information. This can include fill reports, cancel reports and new order notifications. The Operations application **140** has the following responsibilities: start and shutdown the SBT system; start and stop trading of a product; change the status of a product's market (pre-open, open, close, halt, etc.); present logged system events; maintain SBT-specific trader information; maintain SBT-specific product information; maintain trading parameters (quote width, minimum market-maker order default size, required percent of responses to a request for quote (RFQ), maximum response time to an RFQ, etc).

The functionality of the Trader **136**, Market-Maker **137**, Clearing Firm Broker **138**, and Back Office **139** modules is exposed by a facade, the Member Interface (MI) Application Programming Interface (API) **135**. The Member Interface **135** exposes different subsets of functionality depending on the user that logged on to the system. The intention behind sharing a common API among the different trader classes is to allow workstations to service all of them. Separate API's may alternatively be used for the different user classes.

The Member Interface API **135** supports both SBT client applications and external applications owned by members. Members use the Member Interface API to link their existing computer systems to the exchange system **100**, to submit orders electronically and to automate trading. Likewise, market-makers use the API to submit autoquotes employing their proprietary systems, instead of the default autoquote application **161** provided by SBT.

The following system functions are preferably accessible through the API: session logon and logoff; market state inquiry and change notification; connection status inquiry and change notification; order entry, cancellation, and replacement; quote entry, cancellation, and replacement; RFQ notification; order status inquiry and fill notification; subscription to product markets; best market quotes notification; book "depth" inquire and change notification.

Referring now to FIG. **2**B, the Business Services module **132** contains the core functionality of the automated exchange system **100**. It includes components that correspond to the key business object model entities of the automated trading system such as members, orders, books, products, quotes, et cetera. In addition, it includes components to administer and operate the system **100**.

The Order Handling Service module **220** maintains the current state of all orders persistently. Specific operations may be exposed directly by Order objects **141**, bypassing the Order Handling Service **220**. Logically, Orders are components of this module. Specifically, the Order Handing Service **220** and Order components are responsible for: receiving and storing incoming orders (from SBT clients or TPF **156** (FIG. **2**C)); forwarding incoming orders to the Broker module for execution; receiving order state change notifications from the Broker and Order Book modules and updating stored orders with this information (the functionality is provided by exposing Orders, allowing the Broker and Order Book components to directly update the orders); sending fill reports to originating traders upon receiving fill notifications from the Broker and Order Book modules; receiving order cancellation requests and forwarding them to the Broker and Order Book modules (upon confirmation of a cancellation, notifying the originating trader of the result of the request and updating the stored state of the order); and receiving order cancellation/replacement requests and forwarding them to the Broker and Order Book modules (upon confirmation of the cancellation/replacement, notifying the originating trader of the result of the request and updating the stored state of the order).

The Broker Service module **230** is responsible for executing the following types of orders: limit, market, all or none, fill or kill, immediate or cancel, stop, stop limit, and spread. Upon trade execution, the Broker Service **230** is responsible for notifying the Trade Service module **143** of all the orders matched (all parties to the trade) in the trade. It is also responsible for notifying the Order Handling Service (i.e. Orders) **220** and Market-Maker Quote Service (i.e. Quotes) **240** of the fills.

The responsibilities of the Order Book Service module **142** are: cooperate with the Broker Service **230** in calculating the opening price during a product's pre-opening period; acknowledge that an order was accepted by publishing an event consumed by the Trader application **136** which originated the order; cancel and cancel/replace resting orders; upon changes to the top of the book, publish the new Book Best Bid Offer (BBBO) and last sale.

The responsibilities of the Trade Service module **143** are: receive trade notifications from the Broker Service **230**; format trade reports; store trade reports; and forward trade reports to trade match (via TPF **156**).

The Market-Maker (MM) Quote Service module **240** is responsible for: receiving requests for quotes (RFQs) from traders; submitting RFQs to market-makers assigned to the product for which the quote was requested (by publishing in the RFQ event channel); receiving and logging market-maker responses to RFQs (market-maker quotes); upon receiving a market-maker quote, saving it persistently and submitting them to the Broker Service module **230** for execution; sending fill reports to originating market-makers upon receiving fill notifications from the Broker and Order Book modules; canceling or updating a Market-Maker quote upon receiving a request from the originating market-maker by submitting the request to the Broker/Order Book; canceling or updating or regenerating Market-Maker quotes upon receiving a fill report; upon inquiry, providing the history of the quotes submitted by a market-maker.

The Product Service module **144** maintains all product-related information. In order to perform its responsibilities, the Product Service module **144** downloads, and preferably caches, product information from TPF **156** and TIPS **157**. The User Service module **260** maintains all user-related information, both specific to SBT and contained in the Membership System. It provides a unified interface to SBT components accessing user information, hiding the actual location of the maintained data, thus simplifying client logic.

The User Service module **260** maintains the information of traders, market-makers, clearing firm brokers, operators, help desk personnel, back-office personnel. In one embodiment, the data is cached for performance reasons and the data is synchronized from the TPF **156** source.

The Trading Session Service module **145** maintains all business day and trading session-related information and manages the different states of a trading session, e.g. open, closed, and halted. Products that are processed/traded in each trading session are also kept at this service. In order to perform these responsibilities, the Product Service module **144** downloads trading session and product information from TPF **156**, as well as monitor events that affect products traded within a session.

The Product State Service **146** is responsible for coordinating product state changes for all products, e.g. pre-opening, opening, trading, halting, closing, and post-closing. It works closely with the Broker Service **230** to insure that state changes occur in a timely fashion. The service **146** monitors events that affect products traded, such as monitoring the underlying market to detect when the primary exchange opens, closes or halts trading a product. The Product Configuration Service **147** is responsible for providing the location of where a product is processed/traded. This information is primarily used to route product-specific requests (e.g. orders) for processing. The Order Status Service **148** provides subscription and notification services related to orders (i.e., fill reports, cancel reports, order accepted by book, etc.).

The Quote Status Service module **149** provides subscription and notification services related to quotes (i.e. fill reports, deletion reports, etc.) The service **149** preferably replaces the use of event channels for quote status reporting, providing a more secure mechanism for status delivery. The Market Data Service **150** maintains a current snapshot of market data, in addition to publishing market summary data. The module also provides an interface to clients to query historical market data.

The Best Quote module **151** is responsible for calculating the market best (aggregate quantities of buy and sell orders at the best price) for each product and sending them to TPF **156** (which in turn forwards them to the Options Price Reporting Authority) for public dissemination. In addition, it is responsible for calculating and disseminating the National Best Bid Offer (NBBO). In order to provide this information, the Best Quote module **151** subscribes to the event channel referred to herein as the Best of the Rest channel to obtain the current best quote from competing exchanges. The Best Quote module **151** then determines the source of the NBBO, whether it is from the present exchange or a competitor, and publishes the results to the Best Quote event channel, of which the TPF Adapter **152** is a subscriber.

Referring now to FIG. **2**C, the External Integration Services module **133** includes adapters **152**, **153**, **154**, and **155**, that map the interaction paradigms of external systems to the ones in the system **100** architecture. The adapter modules "adapt" (or "wrap") the native legacy interfaces to interfaces appropriate in the SBT environment. The TPF (Transaction Processing Facility) module **152** contains the adapter to allow SBT and TPF **156** to interact. TPF data is received, remoduled, and broadcast/delivered to the appropriate components within SBT. Conversely, SBT data is received, either through direct invocation or event consumption, remoduled, and sent to TPF **156** using its native interface.

The Membership Adapter **154** translates requests for member information received from SBT components into requests to the Membership System **159** and returns the results after re-formatting.

The TIPS Adapter **155** subscribes to TIPS **157** to receive the external market data needed in the SBT environment, including underlying market data and the Best of the Rest of options listed in SBT. The Events Service (FIG. **2**D) notifies the TIPS Adapter **155** of consumer subscriptions so that it can propagate these subscriptions back to TIPS **157**. Once subscribed, the TIPS Adapter **155** reformats the market data received from TIPS **157** and publishes it for consumption by SBT components. Another responsibility of this adapter **155** is to publish underlying product state events when external markets change their states, for instance when they open, halt, close, etc.

The Trade Match Adapter **153** receives SBT data and forwards it to TM **158**. The TM Adapter **153** handles the following data flows: Trade Report (SBT to TM)—SBT reports all the parties to a trade to TM **158**.

Referring now to FIG. **2**D, the Infrastructure Services module **134** contains commercial "off-the-shelf" software and extended infrastructure services that provide enterprise-wide support to various other external systems. One mechanism by which the SBT system components interact with each other is by supplying and consuming events, implemented as a publish/subscribe pattern. The following list provides a brief description of the event flows/notification services (messaging services) shown in FIG. **2**D.

RFQ—the Market-maker (MM) Quote Service supplies RFQ events consumed by the Market-Maker Application.

BBBO—the Order Book supplies Book Best Bid Offer (BBBO) events consumed by the Best Quote Service.

NBBO—the Best Quote Service supplies National Best Bid Offer (NBBO) events consumed by the Trader Application, and Market Data Service.

Current Market—the Best Quote Service supplies Current Market Best events, containing a product's best quote, consumed by the Market Data Service and Trader Application. The best quote indicates if the exchange has the best quote.

Best of the Rest—the TIPS Adapter component supplies best-of-the-rest events consumed by the Best Quote Service.

Last Sale—the Trade Service supplies last sale events consumed by the Market Data Service **150** and TPF Adapter **152**.

Last Sale Summary—the Market Data Service **150** component supplies last sale summary events consumed by the Trader application:

Logging—the Logging Service Proxy component supplies Log Service events consumed by the Log Service component.

System Management—the Foundation Framework supplies System Management events consumed by the System Management component.

Instrumentation—the Instrumentation Service component supplies Instrumentation events consumed by both the System Management component and the Log Service component.

Underlying Ticker—the TIPS Adapter supplies Underlying ticker events (prices, quotes, last sales, news alerts) consumed by the Trader Application and the Product Service.

Underlying Recap—the TIPS Adapter supplies Underlying summary events (high and low prices, volume) consumed by the Market Data Service and Trader Application.

Trade Report—the Trade Service supplies Trade Report events consumed by the TPF Adapter **152**.

Product Status—the Product Service **144** and Product State Service **146** supply Product Status events (State, Price Adjustment, and Update) events consumed by the Trader application, Order Handling Service **220**, and TPF Adapter **152**.

Trading Session Status—the Trading Session Service **145** supplies Trading Session State events consumed by the Operations Application **140** and Help Desk application **160**.

End of Session Summary—the Trading Session Service supplies End of Trading Session Status events.

Opening Price—The Broker Service module **230** supplies Opening Price events consumed by the Trader Application **136**.

Control—the Operations **140** and Help Desk **160** applications supply Control events, possibly through the System Management component, consumed by Business Services **132** and External Integration Services **133** components.

Order Status—the Order Handling Service **220** (Order) supplies Fill Report, Cancel Report, Updated Order, New Order, and Order Accepted by Book events consumed by the Order Status Service **148**, and TPF Adapter **152**.

Quote Status—the MM Quote Service **240** (Quote) supply Fill Report, and Delete Report events consumed by the Quote Status Service **149**.

In accordance with a preferred embodiment, there are four major tiers of the application software. The business services **132** handle all the SBT order matching, execution and reporting functionality. It provides the repository for all SBT information data. The application services **210** handle the application presentation and act as the application front end to the business services. Different views of the business services **132** and collaboration of business objects are grouped together and are presented to the user based on logon authentication and authorization level. The two tiers communicate to each other by two supported tiers: the infrastructure services **134** and external integration services **133**. The infrastructure services **134** provide a seamless integration between the application services **210** and business services **132**. The external integration services **133** provide the access to the external system.

With reference to FIG. **3**, a sequence diagram **200** for a preferred embodiment of the automated exchange system **100** is shown. The system **100** includes a client application server **210**, an order handling service module **220**, a broker service module **230**, a quote service module **240**, a user service module **260**, and quote objects **250** and **252**. The service modules **220**, **230**, **240**, **260** and objects **250**, **252** are preferably software modules running on clusters **102**, or on one or more interconnected computers. The software modules are preferably written in an object-oriented programming language and are compiled to run on the clustered computers **102**. Preferably, the software utilizes the C++ language, the Java programming language, or other object-oriented language. Alternatively, any suitable software language may be used to implement the system, as will be understood by one of ordinary skill in the art. The modules also interact with a database program used for storing data and other system and user information. In the preferred embodiment an Oracle database system is used.

The client application server **210**, as discussed above, runs on client servers **110**, **112**, and provides an interface to one or more clients. The client server **110**, **112** may include one or more application modules, depending upon the intended users of the servers **110**, **112**. For example, the client servers **110**, **112** preferably include at least one of a market-maker application, a trader application, a back-office application, or a member interface. The client servers **110**, **112** also preferably utilize a user authentication and role-based security model to control access to the various application modules.

The client server **110**, **112** may also include modules such as a help desk application, an operations application, and a Clearing Firm Broker (CFB) module. The CFB module may be configured to allow a Clearing Firm to set maximum volume limits on a per-class basis. The Help Desk module is preferably enabled for use on client servers that provide connectivity to exchange management personnel. The Help Desk provides a utility to force a user to logout of the system.

The order handling service **220** forwards orders to the appropriate broker service module **230** that handles the class of options to which the individual orders relate. If the broker service module **230** cannot execute the order immediately, it routes it to the order book service module, which maintains the current state of all pending orders and quotes. The order handling service module **220** receives order information from various sources, including brokers, traders, market-makers, etc. The orders may enter the system from a client application server **210** or through an alternative interface such as TFP adapter **152**, which is a connection that allows a pre-existing automated order handling system such as TPF system **156**, to access the present system.

The broker service module **230** is responsible for executing various types of orders, including limit, market, all or none, fill or kill, immediate or cancel, stop, stop limit; and spread orders. Preferably, there are numerous broker service modules **230** running on the exchange server **104**, or on the interconnected computers in the cluster **102**, where each broker service module **230** handles trades for a subset of products offered by the exchange. For example, there is preferably a broker service module **230** for each class of option contracts. The broker service module **230** thus matches incoming orders to other orders or to quotes supplied by market-makers to complete a trade, indicated by line **282** in FIG. **3**.

The broker service module **230** also receives quotes from the quote service **240**, discussed below. The broker service module **230** attempts to execute a trade **282** by matching incoming quotes to orders or to other quotes stored by the order book service module **142** in the order book. Note that for purposes of trade execution **282**, quotes are treated by the exchange system **100** as if they were orders. Thus, when the broker service module **230** receives a quote that it cannot match to an existing order or quote, it sends the quote to the order book for storage with other unfilled quotes and orders. Preferably, quotes differ from regular orders in that a quote may be two sided, having a bid and an offer price, and that each market-maker may only have one quote per product in the system.

To facilitate the order matching process of trade execution **282**, the broker service module **230** has direct access to orders stored in the order book by the order book service module **142**. Preferably, when the incoming order is matched to an existing quote supplied by the quote service module **240**, the broker service module **230** provides the quote service module **240** with details of the trade.

The quote service module **240** manages the quotes supplied by market-makers via client application service module **210**. The quote service module **240** submits the quotes to the broker service module **230** for execution. The quote service module **240** ensures that each individual market-maker has only one quote per product in the system at any given time. When a market-maker enters a new quote on a product for which he already has an outstanding quote, the quote service module preferably determines whether there is already an

existing quote in the system for that market-maker and, if so, informs the broker service module **230** that the pre-existing quote is to be cancelled. The quote service module **240** submits the new quote to the broker service module **230** only after it has received acknowledgement from the broker service module **230** that the pre-existing quote has been cancelled.

The broker service module **230** issues fill reports to notify various other modules, and ultimately the trading entities, that the trade was executed. Upon notification of a fill **284** from the broker service module **230** (or the order book module), the quote service module **240** informs the quote object **250**. In turn, the market-maker is notified of the fill via the exchange's reporting system. The quote service module **240** also cancels or updates a market-maker quote upon receiving a request from the originating market-maker by submitting the request to the broker service **230**. The quote service module performs this by first informing broker service module **230** that the pre-existing quote has been cancelled. The broker service module **230** then removes the quote from the order book and confirms to the quote service **240** that the quote has been cancelled. The quote service **240** then submits the new quote (if one exists) to the broker service module **230**.

With respect to FIG. **3**, a preferred sequence of events and messages will be described. Market-Makers log into a client application server module **210** and access the user service module **260**. The market-maker communicates with the user service module **260** through a terminal, such as a workstation or wireless handheld unit. As shown by line **270**, trading parameters, or quote parameters, are sent to the user service module **260**. Upon initialization of the quote service, or upon login of a new market-maker, various trading parameters are provided to the quote service module **240** as shown by line **271**. The trading parameters may include a risk threshold, a quote regeneration indicator, a quote regeneration increment, a quote modification indicator, and a quote modification increment. The parameters may include numerous sets of thresholds, indicators, and increments, preferably one such set for each class for which the market-maker is providing quotes.

The quote service module **240** receives quotes from market-makers as shown by line **272**, and provides these quotes to the quote objects **250**, **252**, as shown by update lines **273**, **274**, and to the broker service module **230** as shown by line **276**. As mentioned above, the quote service module **240** will not forward updated quotes (as opposed to new quotes) to the broker service module **230** before first canceling old quotes.

Orders received by the client application server **210** are routed to the order handling service **220** as shown by line **278**. The order is then forwarded to the appropriate broker service **230** as shown by line **280**. The broker service module **230** attempts to execute every order or quote received with the best order (or quote) in the book as shown by line **282**. When a trade is executed, a fill report is issued to the quote service module **240** as shown by line **284**. The quote service module **240** then analyzes the trade and determines whether the market-maker's risk threshold has been exceeded, as shown by line **286**. The threshold test will be described in further detail below. A fill report is sent to the quote object **250** as shown by line **288**. The quote object **250** then informs market-maker of the fill through the use of a trade report service module (not shown).

In addition, at steps **286** and **287**, the quote service module may modify quotes in response to the trade in accordance with the market-maker's trading parameters, as discussed below. The quote service module then reports the new quotes to the broker service module **230** as shown by line **290**. The broker service **230** acknowledges the quote updates as shown by line **292**. If the broker service **230** has already processed additional trades against the original quote, then the broker service module **230** would respond with a "too late to cancel" message. Once the update acknowledge has been received, the quote service module **240** updates the quote objects **250**, **252**, as shown by lines **294**, **296**. The quote objects then inform the market-maker that its quotes have been updated.

Risk Measurements and Risk Thresholds

In a preferred embodiment of the automated trading system **100** having integrated order modification and quote risk monitoring, the aggregate risk of a market-maker's recent trades is calculated after each trade. The measurement preferably includes either calculating an equivalent stock position, i.e., a net delta (by, for example, summing delta values for all contracts traded by the market-maker associated with the option series in the class), or calculating a net gamma, theta, or vega.

In particular, the aggregate risk measurement is preferably the net delta of all the trades for a specific market-maker or a designated group of market-makers in a given class in a given period of time. The quotes in a given class submitted by a market-maker (or a group of market-makers) are referred to herein as a quote group. The rules for delta calculations are as listed below:

Calls (delta value Δ is positive)
- Market-maker selling
- Market-maker position will be Negative Delta
- Market-maker buying
- Market-maker position will be Positive Delta

Puts (delta value Δ is negative)
- Market-maker selling
- Market-maker position will be Positive Delta
- Market-maker buying
- Market-maker position will be Negative Delta

The aggregate risk net delta is defined as:

$$\Delta_{NET} = \sum_i S_i \cdot \Delta_i \cdot U_i \cdot K_i, \quad (1)$$

which is the summation for i trades of the product of S, the sign of the trade, where S is positive when a market-maker buys and negative when a market-maker sells, Δ (delta), which is rate of change of the price of the individual series with respect to the stock, and ranges from −1.0 to 0 for puts and 0 to 1.0 for calls, U, which is the unit of trade, i.e. the number of shares, and K, the number of contracts traded by the market-maker.

The aggregate risk measurement is preferably based on the net delta Δ_{NET} for the entire class of options, which is the sum of all the deltas for a given market-maker's trades in all series of a class. The delta contribution for each trade is calculated every time a trade occurs for any series in the class. The aggregate risk is then calculated by summing delta contributions from only the most recent trades. The values for the theoretical deltas Δ_i are preferably obtained by an autoquote system (not shown) associated with the exchange system **100**, and more particularly with the business services package **132**.

Autoquote systems provide pricing information, and specifically theoretical delta values Δ_i, using well-known algorithms that utilize standard parameters, as is understood to those of skill in the art. Most of the parameters associated with calculating an individual series delta value are objective data, such as the date, strike price, the price of the underlying security, etc. Other autoquote parameters have acceptable default values that may be used, such as using the broker loan

rate for the interest rate, etc. One parameter that may be more subjective among individual market-makers is the volatility parameter. Thus, the system **100** may be designed such that each quote submitted by a market-maker includes a volatility field to be used by the system in determining the individual theoretical delta value Δ_i. The theoretical delta value Δ_i may then be calculated either as part of the threshold, test, or may be periodically updated at a rate sufficient to provide a fairly accurate delta value Δ_i. In this way, the system **100** provides the market-maker with further control over the quote risk monitoring system.

Because the exchange quote modification service is intended to address increased risks associated with a rapid sequence of trades, older trades need not be included because the market-maker has had an opportunity to manually intervene and modify his quotes. Thus, the aggregate risk measurement may be based on the last N trades, where N is a trading parameter specified by the market-maker, or may be based on trades occurring within a specific time frame. The duration of the time frame may be specified by the market-maker by providing a time window parameter t_K, which is included as a trading parameter. Alternatively, a default value for t_K may be used.

Alternatively, the risk threshold and risk measurement may include an aggregate gamma measurement. Gamma is known to those of skill in the art to be the rate of change of the delta parameter with respect to the rate of change of the underlying security, such as the stock. An aggregate gamma measurement provides an indication of the rate at which an aggregate delta measurement will change. Net gamma values are negative when a market-maker is a net seller of contracts, and positive when a market-maker is a net buyer of contracts. As a further alternative, either theta, which is the rate at which option prices change over time, or vega, which is the change in an option contract that results from, a change in its volatility, may be included.

The market-maker may provide a single threshold Δ_{NETMAX} such that if the absolute value of the aggregate risk exceeds the threshold, then the quotes are modified according to the rules set forth below. The market-maker may also provide positive and negative thresholds Δ^{+}_{NETMAX} and Δ^{-}_{NETMAX} to accommodate a market-maker's pre-existing risk bias.

In an alternative preferred embodiment, the market-maker's risk is determined by calculating the net contract volume traded within a specified time. The net contract volume K_{NET} may be calculated by using equation (1) above, with the exception that the delta value is replaced by the sign of Δ, or ±1, where calls are positive 1, and puts are negative 1:

$$K_{NET} = \sum_i S_i \cdot \text{sign}(\Delta_i) \cdot U_i \cdot K_i, \text{ for each trade, } i. \quad (2)$$

The result is that the volume of each trade is treated as a positive or negative value, depending upon the nature of the trade—selling calls and buying puts have negative contributions, and buying calls and selling puts have positive contributions. The sum of the trades is then calculated to provide a net difference between the number of short calls plus long puts and long calls plus short puts. Thus, the market-makers may specify a threshold in terms of a maximum net contract volume offset, K_{NETMAX} (or positive and negative thresholds K^{+}_{NETMAX} and K^{-}_{NETMAX} to accommodate a market-maker's pre-existing risk bias). As stated above, the system may be configured to also allow the market-makers to specify a time window parameter t_K that specifies which trades should be included in the risk calculation. Thus, only the contracts K that have been executed within the previous t seconds will be included in equation 2. Alternatively, the system may be configured to specify i, the number of previous trades to include in the risk calculation.

In still further embodiments, the aggregate risk measurement may be simplified by calculating the total number of put or call contracts (or deltas) that have been sold or bought within a given time frame or within that last N trades. Thus, for example, when a market-maker has just sold a put, the quote service module **240** may calculate the total number of puts sold (or the delta due to all the puts sold) within the given trading window and compare it to a threshold. If the next trade is a call purchase, then the system would calculate the contracts or deltas for the calls purchased. Thus, if any of the four aggregate volume quantities (buying calls, selling calls, buying puts, selling puts) exceeds a threshold (within a certain time period, or certain number of trades), the quote modification module **340** modifies the quotes appropriately. Alternatively, the quote service module **240** may calculate the total calls bought plus puts sold, and the total calls sold plus puts bought, and notify the quote modification module **340** if either of these aggregate values exceeds the threshold. As a further alternative, the quote service module may use a weighting scheme to calculate aggregate values described above. Specifically, in-the-money options (options with intrinsic value) may be weighted more heavily than at-the-money or out-of-the-money options. In one preferred method, the in-the-money options are weighted with a factor of two, at-the-money options are weighted with a factor of one, and out-of-the-money options are weighted by a factor of one half. These simplified risk measurement and threshold tests perform adequately due to the nature of trading activities that typically result in large risk exposure.

It should also be noted that the market-makers may be grouped together for purposes of risk exposure analysis. That is, the total risk may be calculated based on the trades of one or more market-makers. The market-makers provide a group identification parameter(s) indicating which other market-makers' trades should be included in the risk calculation. In this manner, market-makers acting in concert on behalf of a single organization may coordinate their quote modification.

Automatic Quote Modification

The quote service module **240** of the exchange system **100** includes a quote modification service module **340**. The quote modification service module **340** may be implemented as part of the quote service module **240**, or may be a separate service module. It may also take the form of a separate quote factory module for generating new instantiations of quote objects. The quote modification service module **340** performs quote modification by preferably automatically revising, canceling, or regenerating quotes. The quote modification service module **340** resides on the exchange system computer **104**, **106**, or computer cluster **102**. The quotes are modified by the exchange system in an automatic manner that does not require further input from the market-maker in the form of quote cancellation requests and submission of new quotes by the market-maker or his computer. In this way, the exchange system performs quote modification immediately and without the transmission delays inherent in communication systems and without delays associated with processing queued cancellation requests received from a remote location.

If the quote service module **240** determines that the threshold(s) have been exceeded, the quote service module **240** determines revised quotes and forwards them to the broker service module **230** and the quote objects **250**, **252**. The

revised quotes can take numerous forms. In a first embodiment, the quote service module **240** revises quotes by canceling all outstanding quotes in the class, thereby preventing any further trades from executing and giving the market-maker time to provide revised quotes. In this embodiment, the quote service module **240** sends quote update messages **290** in the form of cancellation messages to the broker service module **230**. The broker service **230** then removes those quotes from the electronic book. Because the threshold test is performed by the exchange system **100** after each trade, the cancellation messages are therefore preferably processed before any further trades can be executed. This is possible because the cancellation requests are not sent from a remote node on a wide area network, such as a market-maker's computing platform, but are generated by the exchange system **100**. This provides the advantage of eliminating a cancellation message queue, as would be used when sending cancellation requests from a remote node, thereby improving quote update times and providing risk management.

In a second embodiment, the quote service module **240** revises quotes by reducing the quantity associated with the existing quotes in the class thereby reducing the amounts of potential further trades and reducing the market-maker's exposure to more risk. The market-maker may specify the amount of the volume decrease by way of an increment value. In this embodiment, the quote service module **240** sends quote updates **290** by first sending quote cancellation messages to the broker service module **230**, and after acknowledgment, sending the revised quotes to the broker service module **230** for execution or booking. Again, because the threshold test is performed by the exchange system **100** after each trade, the cancellation messages are therefore preferably processed before any further trades can be executed. As above, this is possible because the cancellation requests are not sent from a remote node on a wide area network, such as a market-maker's computing platform, but are generated by the exchange system **100**.

In a third embodiment, the quote service module **240** revises quotes by decreasing the bid and offer values of some quotes and increasing others in an attempt to cancel some of the risk already assumed by the market-maker. The quote service **240** does this by automatically adjusting quotes to favor trades that will tend to provide offsetting risk. Specifically, if the threshold (K_{NETMAX} or Δ_{NETMAX}) has been exceeded by a high positive-valued net delta (or K), then the net delta (or K) may be offset by trades having a negative delta (or K). As set forth above, those trades would include selling calls and buying puts. Similarly, if the threshold has been exceeded by a high negative-valued net delta (or K), then the aggregate risk may be offset by trades having a positive delta (or K), or by selling puts and buying calls. Of course, to produce the desired trades, the lowering of offer values of quotes will tend to result in more selling activity by the market-maker, and the raising of bid values will result in more buying activity by the market-maker. In this embodiment, the modification increment is specified by an increment value. As in the previous embodiment, the quote service module **240** sends quote updates **290** by sending quote cancellation messages to the broker service module **230**, and after acknowledgment, sending the revised quotes to the broker service module **230** for execution or booking. Again the automated risk monitoring system and quote modification service of system **100** provides advantages in that the market-maker need not cancel previous quotes and submit new quotes while still being exposed to the possibility of further trades being executed.

The quote service **240** may also modify quotes by regenerating the just-filled quote. This may be performed even if the market-maker's risk threshold has not been exceeded. The market-maker is able to specify quote regeneration parameters via client application server **210** that are stored in the user service module **260**. The parameters specify which products are enabled for quote regeneration, and the extent to which the quotes are to be regenerated. The market-maker may therefore specify, on a product-by-product basis, how many times the quotes are to be regenerated after each quote has been filled. This is referred to herein as the regeneration number parameter. The market-maker may also specify whether the regenerated quotes are to have the same bid and offer values, or are to be backed-off from the previous trade. This parameter is referred to herein as the regeneration increment. That is, for a two-sided quote, if the market-maker has just sold a quantity of contracts at his offer price, the regenerated quote may have a higher offer value. Preferably the bid value is also raised accordingly to maintain a desired or required spread in bid and offer quotes. If, on the other hand, the market-maker has just bought a quantity of contracts at his bid price, the regenerated quote may have a lower bid value. The market-maker also has the option of specifying on a per-class basis the values of the regeneration number parameter and the regeneration increment parameter. The quote regeneration is preferably not performed if the market-maker risk threshold has been exceeded, unless the market-maker has specifically selected quote revision in the event the risk threshold has been exceeded.

With reference to FIG. **4**, the method of quote modification **300** will be described. Upon execution of a trade at step **310**, the quote service module **240** at step **320** checks to see whether the individual market-maker's risk threshold has been exceeded. As mentioned above, the risk measurement and threshold test may be performed using a variety of methods, and certain market-makers' trading activities may be combined for the purposes of risk exposure. If the threshold has not been exceeded, then at step **330** the quote service module **240** preferably checks to see whether the market-maker whose quote has been executed has indicated the desire to have his quotes regenerated. If not, then the process has completed. In the event that the result of either inquiry **320**, **330** is affirmative, then the quote service **240** modifies the quotes with the quote modification module **340** as described above.

Quote modification module **340** includes quote regeneration module **350** and cancel or revise quote module **360**. As mentioned above, the quote modification module **340** may be integral to quote service module **240**, or may be included in a quote factory module, or may be a separate service module. The quotes are regenerated, cancelled, or revised, for example as described above, and submitted as shown in step **370** to the broker service module **230** for execution.

Preferred embodiments of the present invention have been described herein. It is to be understood, of course, that changes and modifications may be made in the embodiments without departing from the true scope of the present invention, as defined by the appended claims. The present embodiment preferably includes logic to implement the described methods in software modules as a set of computer executable software instructions. A Central Processing Unit ("CPU"), or microprocessor, implements the logic that controls the operation of the transceiver. The microprocessor executes software that can be programmed by those of skill in the art to provide the described functionality.

The software can be represented as a sequence of binary bits maintained on a computer readable medium including

magnetic disks, optical disks, and any other volatile or (e.g., Random Access memory ("RAM")) non-volatile firmware (e.g., Read Only Memory ("ROM")) storage system readable by the CPU. The memory locations where data bits are maintained also include physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the stored data bits. The software instructions are executed as data bits by the CPU with a memory system causing a transformation of the electrical signal representation, and the maintenance of data bits at memory locations in the memory system to thereby reconfigure or otherwise alter the unit's operation. The executable software code may implement, for example, the methods as described above.

It should be understood that the programs, processes, methods and apparatus described herein are not related or limited to any particular type of computer or network apparatus (hardware or software), unless indicated otherwise. Various types of general purpose or specialized computer apparatus or computing device may be used with or perform operations in accordance with the teachings described herein.

It should be understood that a hardware embodiment may take a variety of different forms. The hardware may be implemented as an integrated circuit with custom gate arrays or an application specific integrated circuit ("ASIC"). Of the course, the embodiment may also be implemented with discrete hardware components and circuitry. In particular, it is understood that the logic structures and method steps described herein may be implemented in dedicated hardware such as an ASIC, or as program instructions carried out by a microprocessor or other computing device.

The claims should not be read as limited to the described order of elements unless stated to that effect. In addition, use of the term "means" in any claim is intended to invoke 35 U.S.C. §112, paragraph 6, and any claim without the word. "means" is not so intended. Therefore, all embodiments that come within the scope and spirit of the following claims and equivalents thereto are claimed as the invention.

We claim:

1. A system for processing trades of securitized instruments based on security orders and quotes received from client computers, comprising:

at least one server computer comprising a memory, and a processor, said server computer configured to perform the steps of:

receiving orders and quotes, wherein specified ones of said quotes belong to a quote group, and wherein said specified ones of said quotes have associated trading parameters comprising a predefined number of bought or sold contracts relating to said quote group;

generating a trade by matching said received orders and quotes to previously received orders and quotes;

storing each of said orders and quotes when a trade is not generated;

determining whether a quote having associated trading parameters has been filled as a result of the generated trade, and if so, determining a number of contracts that have been bought or sold within said quote group, including the generated trade;

comparing said number of contracts that have been bought or sold within said quote group with said predefined number of bought or sold contracts relating to said quote group; and,

automatically modifying at least one of the remaining specified ones of said quotes in the quote group if said predefined number of bought or sold contracts is exceeded.

2. The apparatus of claim **1**, wherein the number of contracts that have been bought or sold comprises a total number of put contracts bought or sold.

3. The apparatus of claim **1**, wherein the number of contracts that have been bought or sold comprises a total number of call contracts bought or sold.

* * * * *

CERTIFICATE OF SERVICE

I hereby certify that on this 18th day of September, 2015, the foregoing OPENING BRIEF OF APPELLANT CHICAGO BOARD OPTIONS EXCHANGE, INCORPORATED was filed electronically with the U.S. Court of Appeals for the Federal Circuit by means of the Court's CM/ECF system. I further certify that the foregoing was served by means of electronic mail, as well as by the Court's CM/ECF system, which should have sent a Notice of Docket Activity, upon the following counsel of record:

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CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE REQUIREMENTS

1. This brief complies with the type-volume limitation of Federal Rule of Appellate Procedure 32(a)(7)(B) because this brief contains 13,950 words, excluding the parts of the brief exempted by Federal Rule of Appellate Procedure 32(a)(7)(B)(iii).

2. This brief complies with the typeface requirements of Federal Rule of Appellate Procedure 32(a)(5) and the type-style requirements of Federal Rule of Appellate Procedure 32(a)(6) because this brief has been prepared in proportionally spaced typeface using Microsoft Word in 14-point Times New Roman font.

Dated: September 18, 2015

/s/ Steven M. Lieberman
Steven Lieberman